# ATTACHMENT 3. WORK PLAN

## INTRODUCTION

### Goals and Objectives

The Regional Water Management Group of the Antelope Valley Integrated Regional Water Management Stakeholder Group has selected to apply for a Proposition 84 IRWM Implentation Grant to fund a single project benefitting the entire Region – the Water Supply Stabilization Project No. 2 (WSSP2). The WSSP2 is a groundwater banking project that will increase the reliability of the Antelope Valley Region's water supplies by storing excess water available from the State Water Project (SWP) during wet periods and recovering it to serve it to customers during dry and high demand periods or during a disruption in deliveries from the SWP. By "banking" excess water for future use, the WSSP2 will significantly reduce the Region's dependence on constant water deliveries from the Delta. The WSSP2 will also help to stabilize the groundwater basin and preserve agricultural land and open space.

### Purpose and Need

The Antelope Valley Integrated Regional Water Management Plan (AVIRWMP) established 12 objectives and planning targets for the Region. The WSSP2 will help meet 5 of the 12 objectives of the IRWMP:

1. Provide reliable water supply to meet the Antelope Valley Region's expected demand between now and 2035.
2. Establish a contingency plan to meet water supply needs of the Antelope Valley Region during a disruption of SWP water deliveries
3. Stabilize groundwater levels at current conditions
4. Preserve open space and natural habitats that protect and enhance water resources and species in the Antelope Valley Region
5. Maintain agricultural land use with the Antelope Valley Region

Water storage is a critical component of improving water supply reliability and is of particular concern in the Antelope Valley where water supplies available to the Region from the SWP vary significantly throughout the year and from year to year depending on precipitation and environmental constraints in the Bay Delta.

The AVIRWMP identified the need to store up to 250,000 acre-feet of water to meet demands during multi-dry year conditions or disruptions in the SWP. In addition, The Antelope Valley-East Kern Water AVEK (AVEK) is the third largest State Water Project Contractor in the State and, in cooperation with the other water wholesalers and retailers in the Region has analyzed the most suitable locations and methods for water storage in several technical studies and reports. Based on these studies and reports, groundwater basin banking is the most appropriate and efficient storage mechanism.

The need for groundwater storage may also increase significantly in the near future as a result of the pending adjudication of the Antelope Valley Groundwater Basin. The WSSP2 could potentially serve as a major component of the physical solution for the Antelope Valley Groundwater Basin by providing for better management of the SWP water available to the Region.

Studies conducted by the United States Geological Survey (USGS) of the project site have shown that 400 of the total 1500 acres yield the highest potential for recharge. The remaining acreage is more limited in recharge ability and will be first reserved for farming and open space.

## Project List

This Proposal pertains to a single project designated as Water Supply Stabilization Project No. 2 (WSSP2). WSSP2 is a groundwater recharge and recovery project establishing an operational groundwater bank. WSSP2 includes the following components:

1. Development of 400 acres of recharge basins;
2. Increasing the output capacity of AVEK's existing West Feeder of the California Aqueduct with two new turnouts serving the recharge ponds.
3. Construction of 5 recovery wells;
4. Construction of collector pipelines from the wells;
5. Construction of a 7-mile transmission pipeline from the collector pipelines to;
6. A pump station that will pump the water into AVEK's existing potable transmission system for delivery to customers.

The recharge sites are a part of a 1,500 acre parcel owned by AVEK. The land on which the recharge area will be constructed has historically been used for growing alfalfa and row crops. The recharge area was selected based on studies performed by the USGS. Refer to file 2 of this attachment. Based on USGS's work, it is expected that the percolation rate of raw water placed in the recharge area will average about half a foot per day over the 400 acre site. Raw water will be delivered to the site through the existing West Feeder. Allowing for earthen berms between the several recharge basins that will be constructed, total recharge area will be approximately 385 acres.

It is planned to recharge four months per year (November through February)—a period of 120 days. Over 120 days, with an anticipated minimum recharge rate of 0.5 ft/Day, about 23,000 AF could be recharged over the 400 acre site. Any remaining parcels of the property will be used to grow alfalfa and/or row crops or left fallowed when water is not being recharged.

Five recovery wells will be constructed at the recharge site as part of this Project. The wells will be used to withdraw water from the bank as needed to meet water demands throughout the Region.

The seven-mile Recovered Water Transmission Pipeline will move water recovered from the wells to the steel tank at the Recovered Water Pump Station (and steel tank) which will lift the water into AVEK's existing South-North Intertie Pipeline (SNIP). The SNIP is capable of delivering potable water to all AVEK's potable water service areas. Using existing inter AVEK transfer agreements, potable water from the bank can be devliered anywhere in the Antelope Valley Region.

The project is currently at the preliminary design level; i.e., approximately 10% designed.

## Integrated Elements of Projects

The WSSP2 was selected by the AVIRWM Regional Water Management Group in consultation with the local Stakeholder Group as the sole project for which the Region would seek Proposition 84 Round 1 Implementation Grant funds because it benefits every stakeholder in the entire Region. It effectively integrates millions of dollars in existing infrastructure paid for by the region. AVEK's West Feeder and SNIP Pipeline are included in the existing infrastructure. The West Feeder pipeline is a 22 mile 33 to 60-inch diameter transmission pipeline that draws raw water from the California Aqueduct and delivers it to AVEK's Rosamond Water Treatment Plant and to agricultural water users along the pipeline route. The

SNIP pipeline is a 15 mile 48-inch diameter potable pipeline capable of moving potable water to AVEK's potable water customers. As stated earlier, water can be banked at WSSP2 and served directly or through existing transfer agreements to any area of the Region.

In addition to this project, the Region has also committed over $200 million dollars of local funding to projects producing and delivering recycled water to supplement the potable supply. Once the WSSP2 is constructed, stakeholders will engage the Lahontan Regional Water Quality Control Board in regards to recharging recycled water at the WSSP2 in the future to supplement raw water supplies.

The project site for the WSSP2 will also be considered as a potential receiving point for stormwater during the development of the Integrated Flood Management Plan that has been initially recommended for funding through a Proposition 84 Planning Grant.

## Regional Map

The Proposal will be implemented within the Antelope Valley Groundwater Basin. Refer to the 10% design preliminary drawings (Drawings 1 – 9) and the regional map (Files 3 and 4 of this Attachment) which identify the location of facilities of the Proposal and proposed monitoring locations.

## Completed Work

- Planning – AVEK has completed a number of studies as listed in the next section of the Work Plan which have evaluated the feasibility of the WSSP2 Proposal. AVEK's officials utilized the recommendations made in these studies to plan the facilities included in the proposed Project. The planning stage of the Proposal is currently about 95% complete and will be completed by the date of award of the grant.

- Environmental – AVEK has completed the environmental review (CEQA) process with the preparation of an Initial Study which determined the need for filing of a Mitigated Negative Declaration (refer to file 5 of Attachment 3). Said Mitigated Negative Declaration (SCH No. 2008071013) and subsequent Notice of Determination (SCH No. 2008071013) were filed with the State Clearinghouse on July 2, 2008 and November 14, 2008 respectively.

- Land Acquisition – AVEK owns the land required to implement the project with the exception of some pipeline easements in Los Angeles and Kern County public roads. Acquiring encroachment permits will be included as part of this project.

- Design – AVEK has completed the upgrade of three existing turnouts and the approval of two new turnouts at the site to be able to deliver over 30,000 of recharge from the West Feeder. Additionally, AVEK has compiled a 10% preliminary design of the remaining components of the Proposal. Refer to files 3 and 6 of this attachment for the respective designs.

- Permitting – AVEK has not initiated any permit applications as of the date of this Proposal, however, much of the infrastructure for the WSSP2 will be constructed on property owned by AVEK. AVEK will coordinate with the Counties of Los Angeles and Kern to acquire necessary permits for constructing pipelines in existing road right of ways. AVEK will apply for the necessary permits from the County and State Departments of Public Health to construct and operate wells on its property.

- Bid Solicitation and Construction – AVEK has solicited and received bids to construct the two new Turnouts to the WSSP2 property from the West Feeder. The construction contract was awarded by AVEK on December 15, 2010 and construction is expected to be completed by April, 2011.

## Existing Data and Studies

The following is a list of existing studies that have been done in support of this project. Any of the studies not included in other attachments can be made available to DWR upon request:

### Antelope Valley Integrated Regional Water Management Plan

The AVIRWMP describes the goals and objectives to be met by this project. The IRWMP was completed in 2007 and is available online at www.avwaterplan.org.

### Water Supply Stabilization Program (WSSP)

This report analyzes and describes several potential surface recharge sites. This project, WSSP2, was the selected location from the several alternatives considered. The report was prepared by Boyle Engineering Corporation in July 2007.

### Initial Study for the Proposed WSSP2 Groundwater Recharge Project

This document contains the project's environmental documentation, including the CEQA checklist. The study was prepared by Hanson Environmental in June of 2008.

### Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of Insitu Arsenic Removal in the North Buttes Area of the Antelope Valley

This is a technical report that looks at the feasibility of constructing and operating an artificial recharge and storage facility. The engineering values determined as part of this report will be used in the design of the WSSP2 basins and recovery wells. The report was prepared by the United States Geological Survey (USGS) in 2010.

## Project Map

See Drawings 1 through 9 of file 3 of this attachment.

## Project Timing and Phasing

The Project will likely be constructed under two construction contracts. As discussed in Attachment 5-Schedule-construction is expected to begin in December 2011 with all facilities needed for the Project being completed by the summer of 2013.

# TASKS

## Budget Category (a): Direct Project Administration Costs

AVEK will be the sole recipient of grant funds and will construct the project on behalf of the Region. This procedure has been agreed to by the RWMG members and the AVIRWM Stakeholder Group.

### Task 1.1– Project Management

This task includes all effort to manage the project team during pre-design, design, and construction as well as preparation and submittal of progress reports to the Department of Water Resources.

**Deliverables:** Preparation of invoices, progress reports, and other deliverables as required.

### Task 1.2 – Labor Compliance Program

AVEK will comply with Public Resources Code section 75075 regarding Labor Compliance Programs.

**Deliverables:** Submission of Labor Compliance Program.

### Task 1.3 – Reporting

AVEK will comply with the reporting requirements as stipulated in the grant.

**Deliverables:** Submission of quarterly progress reports and a final report as specified in the grant agreement.

## Budget Category (b): Right of Way / Easement Plan

AVEK previously purchased property for the recharge ponds and pump station. Easements will be required for the transmission pipeline. To the greatest extent possible, the recharge and recovery well pipeline will remain within AVEK owned property.

### Task 2.1 - Preparation of Legal Descriptions

The engineering consultant will prepare plats and legal descriptions for that portion of the recovery pipeline easement that will cross each property.

### Task 2.2 - Easement Acquisition

A consultant will be hired to perform appraisals of subject properties and act as a right-of-way agent to obtain the necessary easements for the project.

**Deliverables:** Plats, legal descriptions, and executed easements.

## Budget Category (c): Planning/Design/Engineering/Environmental Documentation

### Task Group 3 - Project Assessment and Evaluation

### Task 3.1 - Records Search

Before beginning on the project design, the engineering consultant will search through AVEK files for previous design plans, reports, and studies that will assist in the design of this project.

**Deliverables:** List of applicable reports, documents, and plans.

### Task 3.2 – Topographic Survey

Engineering consultant will perform field surveying and aerial mapping of the project sites for aid in the design of the project and preparation of the legal descriptions and plats for the easements required for the project. It is expected that survey and aerial mapping datum will be the same as those used for the design of AVEK's existing SNIP Pipeline Project.

**Deliverables:** Aerial Survey with topographic and property line data.

### Task 3.3 – Geotechnical Analysis

Engineering consultant will prepare a geotechnical study to define soil characteristics to design the various facilities of the project. The study should define recommendations for pipeline (e.g. thrust blocks, trench backfill, trench shoring, soil corrosion potential), pump station and tank foundations, and surface recharge embankment design.

**Deliverables:** Geotechnical report.

### Task 3.4 - Existing Utilities Search

This task will involve activities necessary to obtain basic information about the existing facilities and utilities on sites for the pipeline, water recharge basin, and pump station. The primary task will include contacting the various public and known private utility owners in the area to determine the rough location and depth of any existing utilities.

**Deliverables:** Existing Utility information request letters.

### Task 3.5 - Operational Plan and Hydraulic Analysis

Design hydraulics for the WSSP2 surface recharge area and the various facilities will be performed under this task. Evaluations of the reaction of the WSSP2 groundwater bank will be evaluated using computer modeling to estimate the variation of groundwater levels with various recharge and recovery operational assumptions. The design hydraulics for the wells and the pipelines will be evaluated for all critical conditions of low and high flow rates and groundwater levels effected by the WSSP2 banked water storage facility. A surge analysis of the recovery and transmission pipelines will be performed and the pump station design criteria will be established.

**Deliverables:** Technical memorandum summarizing Operational Plan and Hydraulic Analysis.

### Task 3.6 – Feasibility Study

The work described in this task has previously been completed by AVEK in cooperation with USGS. The majority of this work was to develop a technical report with USGS that looked at the feasibility of constructing and operating an artificial recharge and storage facility. The report name is “Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of In situ Arsenic Removal in the North Buttes Area of the Antelope Valley”. The Phase I portion of this report was completed in 2010. The additional Phase II of this study includes groundwater recharge monitoring and reporting to be completed by 2014.

**Deliverables:** Final USGS Report, included with this Proposal.

### Task 4 – Permitting

This task includes obtaining the following permits:

- Kern County Encroachment Permit
- Los Angeles County Encroachment Permit
- California Department of Public Health Water Well, Storage, and Treatment Permits
- Lahontan Regional Water Quality Control Board Construction Activities General Permit.
- California Department of Fish and Game Stream Bed Alternation Permit, if defined drainage areas are impacted by final design.
- Los Angeles County Department of Public Health Water Well Construction Permit

**Deliverables:** Final executed permits

### Task Group 5 – Preparation of Construction Plans and Specifications (Project Design)

### Task 5.1 – Recharge Basin Design

The design of the individual basins will be based on the approach of using agricultural flood irrigation methods that include shallow berms that are approximately 3 feet in height and follow the land contours.

### Task 5.2 – Recharge Pipelines Network Design

This task will include the design and preparation of construction documents for the network of pipelines that will feed the various recharge basins. The design will include the two new turnouts from West Feeder. These turnouts will include metering and pressure reducing facilities and pipelines to the recharge basins.

### Task 5.3 - Recovery Well Design

As part of this task, sites for new recovery wells will be selected along with estimating production capacity. After the sites for new wells have been selected the well details will be defined and construction documents will be prepared. The pumps and motors will be designed along with power supply and controls once the wells have been drilled and tested. It is anticipated that the well pump design will be non-ordinary as the water levels from which the wells will have to produce will vary significantly because of the nature of the recharge and recovery operations for WSSP2. This task also includes the design of well discharge piping.

### Task 5.4 – Recovery Well Pipeline Network Design

This task will include the design and preparation of construction documents for the Recovered Water Pipeline Network. The design will include 12, 16, and 27 inch pipe from the well discharge piping to a point connecting the last branch into the Recovered Water Transmission Pipeline.

### Task 5.5 – Recovered Water Transmission Pipeline Design

This task will include the design and preparation of construction documents for about 7 miles of transmission main. The design will include 36 inch pipe from the Recovery Well Pipeline Network to the proposed Recovered Water Pump Station site.

### Task 5.6 – Recovered Water Pump Station and Steel Reservoir Design

This task includes the design and preparation of construction documents for the Recovered Water Pump Station facilities. For the sake of budgetary detail, the task has been broken down into the following subtasks:

#### Subtask 5.6.1 - Civil Design

This task includes the design of the Civil components of the pump station that will include site grading and layout, fencing, manifold piping, pump wet wells, pump selection, steel reservoir, etc.

#### Subtask 5.6.2 - Structural Design

This task includes the design of the structural components of the steel reservoir and pump station building components.

#### Subtask 5.6.3 - Mechanical Design

This task includes the design of the heating and cooling and air compressor equipment for the site.

#### Subtask 5.6.4 - Electrical Design

This task includes the design of the electrical components of the pump station to include power supply, pump motors, variable frequency drives (VFDs), site and building lighting, etc.

#### Subtask 5.6.5 - Instrumentation Design

This task includes the design of the instrumentation equipment for the pump station controls and SCADA systems.

**Subtask 5.6.6 – Landscape and Irrigation Design**
This task includes the design of landscaping to screen the steel reservoir and pump station entrance per the requirements of the CEQA mitigated negative declaration.

**Deliverables:** 30% Plans, 90% Plan and Specifications, 100% Plan and Specifications are typical deliverables for each task.

## Budget Category (d): Construction/Implementation

### Task 6.1 – Construction
This task includes construction of the various Proposal facilities.

**Deliverables:** Submission of quarterly construction progress reports documenting required construction activity as specified in the grant agreement.

## Budget Category (e): Environmental Compliance/Mitigation/Enhancement

### Task 7.1 - CEQA Environmental Documentation
The CEQA documentation required as part of this project was completed in 2008 by AVEK.

**Deliverable:** Approved Mitigated Negative Declaration for the project.

### Task 7.2 - Implementation of Environmental Mitigation Measures, Monitoring and Assessment
Per the adopted environmental documents, the required environmental mitigation measures, monitoring, and assessment will be conducted by AVEK. Refer to the attached Mitigation Monitoring and Reporting Plan in file 7 of this attachment.

**Deliverables:** Environmental monitoring and assessment reports.

## Budget Category (f): Construction Administration

### Task 8.1 - Project Bids Solicitation
This task includes all costs associated with putting the construction contracts to bid and awarding them. This work includes advertisement in both Kern County and Los Angeles County newspapers, duplicating and distribution of bid sets, responding to questions from potential bidders and issuing addenda, conducting a pre-bid meeting on-site, conduct bid opening at AVEK offices, tabulation of bid results, preparation and review of contract documents, and preparation of conformed drawings.

**Deliverables:** Bid package, addenda, newspaper advertisement.

### Task 8.2 – Pre-Construction Meeting
The engineering consultant will conduct a pre-construction meeting at AVEK offices to begin the construction phase of the project. This meeting will be able to address such issues as mobilization, submittal schedule, and answer any questions the contractor may have.

**Deliverables:** Meeting agendas and minutes.

### Task 8.3 – Response to RFI
The engineering consultant will respond to questions from the contractor as they arise throughout the project.

**Deliverables:** Response to RFI’s.

### Task 8.4 – Submittals

The engineering consultant will review submittals and shop drawings of materials and equipment prior to ordering.

**Deliverables:** Response to submittals.

### Task 8.5 – Construction Observation

Construction observers will be present throughout all critical phases of construction. Engineering staff will also deal with any problems during construction such as unknown utilities and permit requirements.

**Deliverables:** Construction observation reports.

### Task 8.6 – Materials Testing

A consultant will be hired to do testing of soil compaction and concrete compressive strength during construction. Materials testing will be done concurrently with construction observation.

**Deliverables:** Materials test reports.

### Task 8.7 - Operational Testing and Startup

The design staff will be present during the operational testing and startup of the facilities to ensure that they are functioning within the design parameters. The systems to be tested include each of the five recovery wells, the pump station, and the SCADA system that will tie these facilities together.

**Deliverables:** Start up Reports.

### Task 8.8 – Progress Pay Estimates

Progress pay estimates will be prepared each month for both of the two construction contracts.

**Deliverables:** Project pay estimates.

### Task 8.9 – Project Close Out

The close out of the project includes creating record drawings, issuing a notice of completion, conducting a final inspection, and finalizing all project files.

**Deliverables:** Record drawings, final inspection report, finalized project files.

## Monitoring and Assessment

### Task 9.1 – Monitoring and Assessment

After the project is complete and in operation, annual monitoring and assessment will be conducted as described in Attachment 6. Because this is an annual rather than capital cost, monitoring and assessment is accounted for in Attachment 7 and not included in the project budget.

**Deliverables:** Project monitoring and assessment plan and reports.

## ATTACHMENT EXHIBITS

File 2 of 7 – Report Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of Insitu Arsenic Removal in the North Buttes Area of the Antelope Valley, USGS, 2010
File 3 of 7 – 10% Preliminary Design Drawings (Sheets 1 – 9)
File 4 of 7 – IRWM Plan Regional Map
File 5 of 7 – Applicant Resolution Adopting Project Mitigated Negative Declaration
File 6 of 7 – WSSP No. 2 Turnout Project Construction Plans
File 7 of 7 – Mitigation Measures Monitoring and Implementation Plan

# Attachment 3 Exhibit

# Report Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of Insitu Arsenic Removal in the North Buttes Area of the Antelope Valley, USGS, 2010

# USGS Report

## Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of *Insitu* Arsenic Removal in the North Buttes Area of the Antelope Valley

# Program: Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of *Insitu* Arsenic Removal in the North Buttes Area of the Antelope Valley

## Phase 1 Results

### *Introduction*

The Antelope Valley East Kern Water District (AVEK) is proposing to construct and operate a groundwater recharge and recovery program on about 1,500 acres of agricultural land in the North Buttes area of the Antelope Valley. AVEK plans on recharging 30,0000 to 36,000 acre-feet per year (acre-ft/yr) of imported water from the California State Water Project by infiltrating the applied water through a 250-ft thick unsaturated zone using low berm flooding. The water will be recharged during the winter months (November through February) when imported water is available and demand for water supplies is low. Only 90 percent of the water delivered for recharge will be recovered by pumping from on site wells for delivery to AVEK customers during periods when surface-water supplies are low. AVEK plans on recovering the recharged water during dry years at a rate of 26,000 to 60,000 acre-ft/yr.

In May 2009, AVEK and the U.S. Geological Survey (USGS) initiated a cooperative water-resources program to assess the feasibility of artificial recharge and storage and the effectiveness and sustainability of *insitu* arsenic removal in the North Buttes area of the Antelope Valley. The objectives of this study are to: (1) determine if the North Buttes site in the western Antelope Valley groundwater basin is suitable for artificial recharge and storage; (2) determine the effects of artificial recharge on water levels and water quality; (3) determine the effectiveness and sustainability of *insitu* arsenic removal in the unsaturated zone; (4) develop modeling tools to facilitate better management of the proposed full-scale artificial recharge and storage project.

The study objectives will be met utilizing a two-phase approach. The first phase will evaluate the feasibility of the site for artificial recharge and storage using existing or readily collected data. If the Phase 1 results indicate that artificial recharge may be feasible, a pilot-scale artificial-recharge project will be implemented to monitor the movement of the applied water through the unsaturated zone and to determine the effectiveness and sustainability of *insitu* arsenic removal by alumina, iron, and manganese oxides on unsaturated materials. High-arsenic groundwater from a nearby well will be used as the source water for the pilot-scale.

Phase 1 of the study was initiated in May 2009 and consisted of three major tasks: (1) Review existing data, (2) Collect new data, and (3) Evaluate data. The results of Phase 1 of the study are summarized by task in this document.

## *Task 1 – Review Existing Data*

Task 1 involved reviewing and compiling available geologic, hydrologic, and water-quality data in the vicinity of the proposed North Buttes recharge and recovery site. The proposed site covers about 1,475 acres in the northwestern part of the Lancaster subbasin of the Antelope Valley groundwater basin (Figure 1).

### Geohydrology

The Antelope Valley is a large sediment-filled structural depression between the Garlock and San Andreas Fault zones (Figure 1). The sediments that fill the depression form the Antelope Valley groundwater basin. The groundwater basin is underlain and surrounded by low permeability rocks, referred to herein as the basement complex. This basement complex consists of pre-Tertiary igneous rocks and Tertiary sedimentary rocks. A series of unconsolidated to partly consolidated deposits of Quaternary to Tertiary age overlies the basement complex and forms the groundwater basin. Dutcher and Worts (1963) mapped these deposits as either alluvial or lacustrine on the basis of the mode of deposition. The alluvium consists of unconsolidated to moderately indurated, poorly sorted gravels, sands, silts, and clays. The older deep units within the alluvium typically are more compacted and indurated than the shallow units (Dutcher and Worts (1963). The fine-grained lacustrine deposits consist of sands, silts, and clays that accumulated in a large lake or marsh that at times covered large parts of the Antelope Valley (Dibblle, 1967). The lacustrine deposits, as mapped by Durbin (1978) and modified by Leighton and Phillips (2003), are not present in the area of the proposed recharge site.

The lateral boundaries of the Antelope Valley groundwater basin, in most cases, are formed by faults or outcropping of the basement complex. The Antelope Valley groundwater basin has been divided into 12 groundwater subbasins on the basis of faults, exposure of the basement complex, groundwater divides, and, in some cases, arbitrary boundaries (Bloyd, 1967). The Lancaster subbasin is the largest and most developed of the subbasins. The Neenach Fault was identified by Bloyd (1967) to form the northwestern boundary of the subbasin. The proposed recharge and storage site lies just south of the Neenach Fault and north of an outcropping of the basement complex, referred to as the Antelope Buttes or North Buttes (Figure 1).

The Antelope Valley groundwater basin was divided into three major aquifers by Leighton and Phillips (2003): the upper aquifer that extends from the water table to an altitude of about 1,950 ft above sea level (asl), the middle aquifer that extends from about 1,950 to 1,550 ft asl, and the lower aquifer that extends from about 1,550 asl to the altitude at which the basement complex is encountered. In the study area, the upper aquifer consists of alluvial deposits of gravel, sand, silt, and clay, and is unconfined. Leighton and Phillips (2003) reported that the alluvial deposits become more indurated and less permeable in the middle and lower aquifers.

Leighton and Phillips (2003) estimated total transmissivity of the Antelope Valley aquifer system using specific-capacity data. They assumed that the hydraulic conductivity of the lower aquifer was 2 ft/d, and then calibrated the hydraulic conductivity of the upper and middle aquifers such that simulated water levels matched measured values and simulated total transmissivity values reasonably matched values estimated from specific-capacity data. The calibrated hydraulic conductivity values in the study area ranged from 2 to 10 ft/d in both the upper and middle aquifers and 2 ft/d in the lower aquifer, resulting in total simulated transmissivity values of about 2,600 to 5,300 $ft^2/d$ (Leighton and Phillips, 2003).

Specific-capacity values compiled from nine existing wells on the proposed recharge site (Figure 2) range from 20 to 111 gallons per minute per foot (gpm/ft) (Table 1). Multiplying the specific capacity (in gallons per minute per foot of drawdown) by a conversion factor of 230 approximates the transmissivity in units of square feet per day ($ft^2/d$) 230 [the conversion factor was developed by Thomasson and others (1960) for valley-fill deposits in the Sacramento Valley of California]. Transmissivity values estimated using specific-capacity data range from 4,600 to 25,400 $ft^2/d$, with six of the values in excess of 9,000 $ft^2/d$ (Table 1). These estimated transmissivity values are significantly higher than the values simulated by Leighton and Phillips (2003) for the study area.

## Water Levels and Movement

Groundwater levels in the Antelope Valley are measured on a semi-annual basis by the USGS in cooperation with Antelope Valley State Water Contractors Association Joint Powers Authority (JPA). Approximately 30 wells are measured within about five miles of the proposed recharge and storage site (Figure 3). The general direction of groundwater flow in the study area is from west to east. Water levels collected in spring 2008, indicate that water levels are more than 100 ft higher in wells west of the proposed site than in wells located on our directly east of the site (Figure 3). The measured water-level differences suggest the presence of a barrier to groundwater flow. Antelope Valley contains numerous faults, which act as partial barriers to groundwater flow (Leighton and Phillips, 2003). The location of a possible fault in the vicinity of the proposed site, inferred from the large water-level differences, is shown on Figure 3.

The depth to water measured at wells on the site ranges from about 240 feet (ft) below land surface (bls) on the western side of the site to about 270 ft bls on the eastern side. Inspection of historical records indicates that water levels have declined about 100 ft in the aquifer beneath the study area since the early 1960s (Table 1).

## Water Quality

Groundwater-quality data collected within the last five years are available from eight wells on the proposed site and four wells within five miles of the site (Figure 4). The total dissolved solids (TDS) concentration of samples from wells on the site ranges 260 to 393 milligrams per liter (mg/L). The TDS concentrations measured in samples from the on site wells are about 50 mg/L higher than TDS concentrations measured from samples in three of the off-site wells. Nitrate concentrations measured as nitrogen range from 1.3 to 4 mg/L in the on-site wells, generally higher than measured in the off-site wells. All nitrate concentrations are below the U.S. Environmental Protection Agency (USEPA) Maximum contaminant Level (MCL) of 10 mg/L as nitrogen (U.S. Environmental Protection Agency, 2009). The higher TDS and nitrate concentrations measured in the on-site wells could be the result of irrigation return flows reaching the water table after irrigation on the site for more than 30 years.

Arsenic concentrations ranged from 3.5 to 27.2 micrograms per liter (μg/L) in samples from the on-site wells (Figure 4). Four of the eight wells sampled on the site yielded water with arsenic concentrations in excess of the USEPA MCL of 10 μg/L (U.S. Environmental Protection Agency, 2009). Wells with high arsenic concentrations are located on the western and northeastern edges of the site. Comparison of arsenic concentrations with well depth did not indicate any obvious relationship. Depth-dependent flow and water-quality samples would help determine the source of the high arsenic concentrations; however, access to the wells was not possible during this study.

## *Task 2 – Collect New Data*

Task 2 involved compiling and collecting data to identify the basin geometry, potential infiltration rates, and the shallow subsurface lithology of the study area.

### Basin Geometry

Gravity data were compiled and collected to help determine changes in the basement geometry and to identify possible features, such as faults, that may influence groundwater flow and the recovery of recharged water. Available regional gravity data (Roberts and others, 1990) was used to produce a preliminary basement gravity model of the study area. Local gravity measurements collected during Phase 1 of the study will be incorporated with existing regional data to prepare a refined basement gravity model during Phase 2 of the study.

Regional gravity data were analyzed using standard gravity corrections, including: (a) the earth tide correction, which corrects for tidal effects of the moon and sun; (b) instrument drift correction, which compensates for drift in the instrument's spring; (c) the latitude correction, which incorporates the variation of the Earth's gravity with latitude; (d) the free-air correction, which accounts for the variation in gravity due to elevation relative to sea level; (e) the Bouguer correction, which corrects for the attraction of material between the station and sea level; (f) the curvature correction, which corrects the Bouguer correction for the effect of the Earth's curvature; (g) the terrain correction, which removes the effect of topography to a radial distance of 104 mi (166.7 km); and (h) the isostatic correction, which removes long-wavelength variations in the gravity field inversely related to topography.

The gravity field (referred to in this document as the isostatic residual gravity field) of the study area is complex, and mostly reflects the large density contrast between dense basement complex and less dense basin-fill deposits. The gravity field was analyzed to define the structural setting of the study area. The automated method of Blakely and Simpson (1986) was used to define where changes in rock density are located over a short distance, such as density contrasts cause by faults. Places where the gravity field changes the most are likely locations for vertical offsets in basement rocks, indicating the location of a possible fault. Faults are often partial barriers to groundwater flow, where they cut unconsolidated basin-fill deposits.

The thickness of the basin-fill deposits was estimated by the method of Jachens and Moring (Roberts and others, 1990). This method partitions the isostatic residual gravity field into two components—the component caused by density variations within the basement rocks (the basement gravity field) and the component caused by the low-density basin-fill deposits (the basin-fill gravity anomaly). Once the gravity data have been partitioned, the ‘basin-fill gravity anomaly’ can be modeled to yield a thickness of the basin-fill deposits throughout the study area, given knowledge of the density contrast between the basin-fill deposits and the basement rocks.

Geologic data collected from wells and test holes in the Antelope Valley were used to constrain the computed thickness of the basin-fill deposits.

The computed depth to the basement complex (thickness of the basin fill) is presented on Figure 5. The gravity data indicate that the depth to the basement complex increases from less than 1,000 ft bls on the northeastern side of the site more than 3,000 ft on the western side of the site. Directly west of the site, the gravity data show that the depth to the basement complex increases to more than 7,000 ft bls. This large change in depth to the basement complex over a short distance is likely the result of a northwest-southwest trending fault that has vertically offset the basement complex. South of the site, the gravity data indicate that the depth to the basement complex is less than 100 to 1,000 ft bls, which corresponds to the exposed basement complex in the Antelope and Little Buttes.

About 100 gravity measurements were collected for this study to improve the gravity model in the vicinity of the proposed site (Figure 1). The gravity measurements were closely spaced near the site to help determine changes in the basement geometry below the recharge facility and to identify possible features, such as faults, that might influence groundwater flow. Gravity measurements collected during this study were made using a LaCoste and Romberg Model D-79 with Aliod 100 gravity meter. The location and elevation of each gravity measurement was determined using a Trimble Real Time Kinematic (RTK) Model 4400 Global Positioning System (GPS) base and mobile receivers. This system is capable of obtaining vertical and horizontal coordinates with a precision of plus or minus 0.083 ft between receiver and base. These data will be incorporate with the regional data to develop a revised gravity model during Phase 2 of the study.

## Infiltration Rate

The proposed site is located on coalescing alluvial fan deposits derived from the Tehachapi Mountains to the north and the San Gabriel Mountains to the west. Soils on the northern part of the site predominantly are classified as the Rosamond series (U.S. Department of Agriculture, 2009), and consist predominantly of loam (Rp), silty clay loam (Rt), and fine sandy loam (Ro). These soils were deposited at the distal end of the alluvial fan (the lower margin of the alluvial fan between the sloping fan and the playa) that extends from the Tehachapi Mountains (Figure 6). Soils on the southern part of the site predominantly are classified as the Hesperia (HkA and HkB) and Hanford (HbA, HbC, and HcA) series (U.S. Department of Agriculture, 2009), and consist of fine sandy loam to coarse sandy loam deposited on the alluvial fan extending from the San Gabriel Mountains (Figure 6). The reported surface saturated hydraulic conductivity of these soils ranges from 1.13 to 3.97 ft/d for the Rp and Rt soils, 3.97 to 11.9 ft/d for the Ro, HkA, HkB, HbA, HbC, and HcA soils (U.S. Department of Agriculture, 2009). The reported values were constant with depth, except for the Ro soil, which were lower (1.13 to 3.97 ft/d) below 8 inches (U.S. Department of Agriculture, 2009). On the basis of the soil description, about 250 acres of the site are considered to have a good infiltration potential (HkA, HkB, HbA, HbC, and HcA soils), about 500 acres are considered to have a fair infiltration potential (Ro soils), and about 725 acres (Rp and Rt soils) are considered to have limited infiltration potential (Figure 6).

Double-ring infiltrometer tests were completed for this study on the different soil types to more accurately evaluate the potential infiltration rate for the different soils on the site. A 4-ft-diameter double-ring infiltrometer, having a 2-ft-diameter inner ring, was used to measure the maximum rate that water could infiltrate a particular soil. Infiltrometer tests were successfully completed on the land surface at six sites, and at about 3-ft beneath the subsurface at four of these sites (Figure 7). Six additional infiltrometer tests were attempted in the northeastern part of the study; however, animal burrows at the sites prevented the successful completion of the tests. Analysis of the infiltration tests indicates that the infiltration rate ranges from 12.75 ft/d in the HkA soils measured at the surface at site 3 to near 0 ft/d in the Rp soils measured at the surface at site 4 (Figure 7 and Table 2). The infiltrometer tests collected at different depths at the same site indicate that the infiltration rates were significantly lower in the deeper tests at the same site in the HkA and Ro soils (sites 1 and 3), were about the same in the Rp soil (site 4), and were higher in the Rt soil (site 5). The infiltrometer test results support the soils property data reported by the U.S Department of Agriculture (2009), and indicate that the sandy loam soils classified as Hesperia (HkA and HkB), Hanford (HbA and HbC), and Rosamond (Ro) soils on the site have fair to good surface infiltration potential; whereas, the loam and silty clay loam soils classified as Rosamond (Rp and Rt) soils on the site have limited surface-infiltration potential.

## Subsurface Lithology

Subsurface lithology data were collect for Phase 1 of the study from Cone Penetrating Testing (CPT), direct-current (DC) resistivity surveys, and test drilling.

## Cone Penetrating Testing (CPT)

CPT data were collected at 23 sites to characterize the subsurface lithology to approximately 50 ft or refusal along north-south and east-west trending transects through the proposed site (Figure 8). The CPT data indicate that the percentage of silt and clay deposits is higher beneath the northern part of the site compared to the southern part of the site (Figure 9). Interpolation of the available CPT data indicates the presence of several continuous thin clay layers (< 5 ft thick) in the upper 50 ft of the subsurface beneath the northern part of the proposed recharge site (Figure 9). Core material collected from the silt and clay layers during CPT had saturated hydraulic-conductivity values ranging from $3.0 \times 10^{-4}$ to $2.0 \times 10^{-2}$ ft/d (Table 2), which are significantly lower than values reported for the soils by the U.S Department of Agriculture (2009). Compaction of the cores during collection may have reduced the hydraulic-conductivity values measured on the CPT cores.

Data collected at CPT01 and CPT24, completed in an area mapped as permeable HkA soil in the northeastern part of the study area (Figure 8), indicate the presence of silt and clay directly beneath the surficial sand deposits (Figure 9A). A core of the clay at 17.7 ft bls in CPT-1 had a saturated hydraulic conductivity of 0.02 ft/d (Table 2). The presence of near surface silt and clay layers in the northern part of the study area would severely limit the downward infiltration of applied recharge water. The CPT data indicate that the HkA and Ro soils in the northeastern part of the proposed recharge site probably would have limited recharge potential due to the underlying silt and clay deposits in the shallow subsurface. On the basis of the soil description and CPT data, about 385 acres of the 1,475-acre site are considered to have a fair (246 acres; Ro soils with no near-surface clay layers) to good (139 acres; Hesperia and Hanford soils with no near-surface clay layers) recharge potential by surface infiltration and about 1,090 acres are considered to have limited recharge potential by surface infiltration (Figures 8 and 9).

Undeveloped land in Section 8, directly south of the proposed site, consists of HkA, HkB, HbA, HbC, and Ro soils which have fair to good surface-infiltration potential. Lithologic data collected from CPT sites adjacent to this property and AVUZ-2 suggests that there are no near-surface clay layers that would inhibit the infiltration of applied water. Adding this land to the proposed recharge and recovery site would significantly increase the recharge potential of the proposed site.

## Direct-Current (DC) Resistivity Surveys

Direct-current (DC) resistivity surveys were collected in the project area to help identify geologic structures and potential perching layers. DC resistivity data were collected along two profiles at the site using a dipole–dipole array with 25-ft electrode spacing to optimize lateral and depth resolution (Figure 8). Inverse models of the DC resistivity data along a north-south profile in the eastern part of the site indicate the presence of relatively low-resistivity material from land surface to the water table in the extreme northern part of the site (Figure 10A). In the remainder of the profile a low-resistivity unit is present from land surface to about 15 ft bls, a continuous high-resistivity unit between 15 and 80 ft bls, and a mid-resistivity unit from about 80 ft to the water table. Low-resistivity units identified by the DC resistivity data were correlated with fine-grained deposits (silt and clay) identified by the CPT, as well as with areas of recent irrigation where residual soil moisture decreased resistivity in the near-surface materials. High-resistivity to mid-resistivity units were correlated with coarse-grained deposits (sand and gravel). The almost continuous low-resistivity materials identified on the northern part of the north-south profile indicate that this part of the proposed site probably would have limited recharge potential by surface infiltration.

Inverse models of the DC resistivity data-along the southeast-northeast profile in the western part of the site indicate the presence of a high-resistivity unit from near land surface to the water table in the southwestern part of the site (Figure 10B). The high-resistivity unit probably is sand and gravel deposits from the San Gabriel Mountains. The presence of the high-resistivity unit suggests that the southwestern part of the site probably would have fair to good recharge potential by surface infiltration. In the remainder of the profile, there is a low-resistivity unit from land surface to about 15 ft bls, underlain by a relatively high-resistivity unit from about 15 ft bls to about 80 ft bls. Beneath this high-resistivity unit, there is a mid-resistivity unit to the water table beneath the southwestern half of the profile; however, this unit becomes progressively less resistive along the northeastern half of the profile. These data support the findings along the north-south profile, indicating that the unsaturated zone is finer grained in the northern part of the site, and probably would have limited recharge potential by surface infiltration.

## Test-Well Drilling

Three unsaturated-zone monitoring sites (AVUZ-1, AVUZ-2, and AVUZ-3) were installed to the water table using the Overburden Drilling and Exploration (ODEX) technique along a north-south profile in the eastern part of the site to determine the lithology and hydraulic properties of the thick unsaturated zone underlying the site (Figure 11 and Table 3). Cuttings were collected at 1 ft intervals for analysis of lithology and core materials were collected at selected intervals for analysis of hydraulic properties. The specific conductance of a mixture of distilled water and soluble salts dissolved from drill cuttings was measured in the field (Figure 12). Borehole geophysical logs, including natural gamma, neutron, and electromagnetic resistivity logs also were collected and were used to help identify the lithology, moisture content, and geologic source of the alluvial deposits (Figure 12). The sites were instrumented to measure the downward movement and quality of existing irrigation return flows and proposed artificial recharge.

### *Methods*

The monitoring sites were drilled to the water table to allow instrument installation throughout the unsaturated zone and at the water table. Cores were preserved on site to prevent changes in water content and water potential using methods described by Hammermeister and others (1986) and Izbicki and others (2000). A gamma log and a neutron log were collected from within the ODEX pipe after drilling was completed. These logs were used with lithologic and specific-conductance data from drill cuttings to guide placement of instruments within the borehole.

A water-table well, advanced tensiometers, temperature sensors, dielectric permittivity sensors, and suction-cup lysimeters were installed in the completed boreholes (Figure 12 and Table 3). The well at each site will be used to measure changes in water levels and groundwater quality resulting from recharge and also will serve as an access for an electromagnetic (EM) resistivity geophysical tool used to monitor the downward movement of water during recharge. Advanced tensiometers are used to measure matric potential and pressure head at depths in the unsaturated zone where perched water may accumulate during artificial recharge. Dielectric permittivity sensors and temperature sensors are used to measure matric potential and temperature in the unsaturated zone. These sensors are commonly placed in coarse-grained deposits or beneath layers expected to impede the downward movement of water. Suction-cup lysimeters are used to collect water samples from the unsaturated zone for laboratory analysis. Instruments were installed at depths determined on the basis of lithologic and geophysical-log data collected during drilling. Each instrument was installed in backfill material intended to ensure adequate contact with the surrounding unsaturated materials. Instruments were separated by low-permeability bentonite grout to ensure water does not move vertically through the borehole. These instruments are controlled and data recorded using a data logger installed in a vault at land surface.

Data will be collected from the advanced tensiometers, temperature sensors, and dielectric permittivity sensors in the unsaturated zone at 4-hour intervals. A period of several months is required for instruments to equilibrate with aquifer material. Therefore, not data from these instruments are presented in this document. Data collected from the instruments will be stored in data loggers and retrieved at approximately 6-week intervals. Water samples from the piezometers will be collected when data are retrieved from the data loggers and analyzed to determine differences in water quality with depth.

### *Results*

The lithologic samples collected at the unsaturated-zone monitoring sites were generalized into three classes: sand, silt, and clay (Figure 13). Borehole data indicate that silt and clay are predominant in the unsaturated zone at in the northern part of the site (AVUZ-3); whereas, sand is predominant in the unsaturated zone at in the southern part of the site (AVUZ-2) (Figure 13). These results confirm the CPT and DC resistivity results. The silt and clay probably were deposited at the distal end of Tehachapi Mountain alluvial fan, similar to the Rosamond soils and the sand probably was deposited by the alluvial fan extending from the San Gabriel Mountains, similar to the Hesperia and Hanford soils. This indicates that through the geologic time period represented by the drill cuttings, the two alluvial fans have been coalescing at approximately the same location on the project site as they are today. Tectonic movement along the Garlock Fault Zone would result in increased erosion in the Tehachapi Mountains and subsequent increased deposition along the alluvial fans extending from the Tehachapi Mountains; similarly, tectonic movement along the San Andreas Fault Zone would result in increased erosion in the San Gabriel Mountains and subsequent increased deposition along the alluvial fans extending from the San Gabriel Mountains. Because of the relative location of the project site to the two fans, increased deposition from the Tehachapi alluvial fan generally will result in deposition of silt and clay on the project site; whereas, increased deposition from the San Gabriel alluvial fan generally will result in deposition of sand on the project site.

Clay deposits are present in the upper 25 ft of AVUZ-3, in the northern part of the site; however, clay deposits are not present until greater than 60 ft bls at AVUZ-1 and 2, in the southern part of the site. Saturated hydraulic conductivity values for core samples of clay collected from the unsaturated-zone monitoring sites range from 0.015 to 0.018 ft/d (Table 3). The presence of low-permeability clay in the near subsurface in the northern part of the site would limit the rate and volume of surface infiltration. The predominance of sand and the absence of clay layers in the near subsurface at AVUZ-1 and AVUZ-2 suggest that the southern part of the site would have a greater potential for recharge by surface infiltration than the northern part of the site.

## *Task 3 – Evaluate Data*

AVEK plans on recharging 30,000 to 36,000 acre-feet per year of imported water from the California State Water Project by infiltrating the applied water through thick unsaturated zone at the North Buttes recharge and storage site. The water will be recharged during the winter months (November through February) when imported water is available and demand for water supplies is low. Only 90 percent of the water delivered for recharge will be recovered by pumping from on site wells for delivery to AVEK customers during periods when surface-water supplies are low. AVEK plans on recovering the recharged water during dry years at a rate of 26,000 to 60,000 acre-ft/yr. The data compiled and collected in Tasks 1 and 2 were used to develop unsaturated and saturated zone models to evaluate the suitability of the proposed site for recharge and storage at the rates and volumes estimated by AVEK.

### Unsaturated-Zone Flow Model

A preliminary, two-dimensional radial flow, multi-phase solute-transport model was developed using TOUGHREACT (Xu and others, 2004) to test the potential efficacy of artificial recharge at the proposed site. TOUGHREACT is a numerical simulation program for chemically reactive non-isothermal flows of multiphase fluids in porous media. The model is radially symmetric, with all geologic layers assumed to be flat lying. The hydraulic properties within the model were estimated based on lithologic data from test drilling, geophysical log data, CPT data, surface geophysical data, and infiltrometer test results. For Phase 1 of the study, preliminary unsaturated-zone models were developed for the geohydrologic conditions present at AVUZ-2 and AVUZ-3.

The radial-flow models are 250 ft deep, extend 2,460 ft radially, and contain 5,300 grid elements. The grid telescopes radially, starting at about 100 ft increments for the initial 10 columns, and then the width of the elements increase by a factor of about 1.3 to a maximum of 180 ft at the furthest extent of the flow model. Vertically the grid for each model is divided into equal 1-ft layers. Each layer of the models was defined as a sand, silt, or clay, based on the geologic data collected during the drilling of AVUZ-2 and AVUZ-3. The vertical saturated hydraulic conductivity values used in the model for the sand, silt, and clay were based on the core data collected and analyzed for this study (table 1), and were 1.56, 0.65, and 0.0165 ft/d; respectively. The horizontal saturated hydraulic conductivity was assumed to be 100 times larger than the vertical saturated hydraulic conductivity. The porosity values used in the model for the sand, silt, and clay were 0.37, 0.49 and 0.46, respectively. The bottom boundary is the water table and the upper boundary is a standard atmospheric with specified head of zero in initial 10 columns, which represents a 100-acre circular pond.

The model was used to simulate the surface infiltration rate beneath the pond and estimate the time for the infiltrated water to reach the water table at AVUZ-2 and AVUZ-3 sites. AVUZ-2 represents the lithology underlying the southern part of the site and AVUZ-3 represents the lithology underlying the northern part of the site. The model simulates that the surface infiltration rate averages about 0.5 ft/d at AVUZ-2 and about 0.07 ft/d at AVUZ-3 after two years of artificial recharge (Figure 14). The model simulates that the infiltrated water reaches the water table after about two years of artificial recharge at AVUZ-2; whereas, the model simulates that the infiltrated water only reaches about 80 ft bls at AVUZ-3 after two years (Figure 15). Model results suggest that about 23,000 acre-ft of water could be infiltrated on the 385 acres considered to have fair to good infiltration potential and about 9,000 acre-ft could be infiltrated on the 1,090 acres considered to have limited infiltration potential during a 4-month period. The low permeability clay layers are modeled as continuous layers; therefore, the simulated infiltration rates and time for the recharge to reach the water table probably represent minimum values. However, physical and biological clogging of the pond was not simulated, which could reduce the surface infiltration rate. Proper management and maintenance of the recharge ponds could limit the effects of physical and biological clogging on surface infiltration at the site. A pilot scale recharge project, as proposed in Phase 2 of this study, is needed to determine the long-term infiltration rate and effective groundwater recharge at the two sites. The instrumented unsaturated-zone monitoring sites installed in the eastern part of the site could be used to monitor the vertical migration of the recharge water, if ponds were constructed adjacent to the sites.

## Saturated-Zone Flow Model

The existing USGS Antelope Valley groundwater flow model (Leighton and Phillips, 2003) was used with particle-tracking software to estimate the effect of artificial recharge on water levels and the movement of water from the site. Of particular importance was estimating the lateral and vertical movement of the recharge water through the saturated zone over time. The three-dimensional model of groundwater flow was developed for the Antelope Valley groundwater basin for the period of 1915-95 as part of a previous USGS study (Leighton and Phillips, 2003). The model was developed using MODFLOW-88 (McDonald and Harbaugh, 1988). The groundwater flow model has been updated using MODFLOW-2005 (MF2K5) (Harbaugh, 2005) as part of an ongoing study in cooperation with Los Angeles County Department of Public Works. The model grid consists of 43 rows and 60 columns with a total of 2,580 square cells. Each cell is 5,280 ft on a side. The aquifer system was discretized vertically into three layers representing the upper, middle, and lower aquifers. The updated USGS groundwater-flow model was used with the particle-tracking software, MODPATH (Pollock, 1994), to determine the effect of artificial recharge on water levels and the movement of water from the site.

The measured water-level differences in wells neighboring the proposed artificial-recharge site compiled in Task 1 for this study suggest the presence of a barrier to groundwater flow, such as a fault (Figure 3). Leighton and Phillips (2003) attempted to simulate the observed water-level difference in the area of the proposed artificial-recharge site by using low hydraulic-conductivity values (2 ft/d) on the western part of the site and high hydraulic-conductivity values (10 ft/d) on the eastern part of the site. Inspection of the modeling results in the area of the proposed artificial-recharge site indicates that this approach did not adequately simulate the observed water-level measurements. For this study, the fault inferred from the water-level and gravity data compiled for this study was added to the model using the Hydraulic-Flow Barrier package (Hsieh and Freckleton, 1993). The conductance of the fault (hydraulic characteristic), which simulates the barrier effect of the fault, was estimated via trial error using measured water levels from nearby wells. In addition, the hydraulic conductivity values for layer 1 east of the fault were increased to 15 ft/d based on the specific-capacity data compiled as part of task 1 (Table 1). The hydraulic-conductivity values for layers 2 and 3 were unchanged from Leighton and Phillips (2003).

The updated groundwater-flow model was used to estimate the effects of artificial recharge at the proposed site. An injection well perforated in layer 1 and located at row 18 and column 20 of the model grid [referred to as model cell (18,20)] was used to simulate artificial recharge. The injection rates were varied with the constraint that simulated hydraulic heads must be at least 50 ft bls to prevent liquifaction. Injection was assumed to occur in the winter months (November-February) over five years. The maximum injection rate (recharge) was about 28,500 acre-ft/yr with a total volume of about 142,500 acre-ft. The simulated year-5 drawdown contours and particle paths are shown in Figure 16 where a negative value indicates a water-level rise. After five years, water levels were simulated to rise about 230 ft at the center of the recharge site. The shape of the recharge mound is asymmetric due to the simulated barrier effect of the Neenach Fault to the north and the unnamed fault identified by this study to the west (Figure 16). Simulated water-level rises were less than 50 ft within one mile of the site and are less than 10 ft within four miles of the site. MODPATH was used to simulate the groundwater travel times and pathlines for advective transport of the recharge water. Eight particles were tracked from the model cell (18,20)–two particles were located along each face of the model cell. The particles on the eastern side of the recharge cell moved a maximum of about 0.75 mile to the east of the site by the end of the five-year simulation period (Figure 17).

The model was used to simulate the maximum volume of water that could be pumped from the site within one year while not allowing simulated hydraulic heads to decline below hydraulic heads measured on the site prior to the artificial recharge (about 1,950 ft asl). Pumping was equally distributed between model cells (18,19) and (18,20) in layer 1. The model results indicate that about 100,000 acre-ft can be pumped from the site (50,000 acre-ft per model cell) during a 1-year period while meeting the hydraulic-head constraint (Figure 17). The simulated water levels at cell (18,20) respond more slowly than at cell (18,19) because it is farther from the simulated fault. Pumpage of 100,000 acre-ft/yr (about 62,000 gpm) would require about 31 wells pumping at a rate of 2,000 gpm. Currently there only are 10 wells on the site, with a combined capacity of less than 33,000 acre-ft/yr (20,000 gpm). Well inefficiencies and well interference would result in lower hydraulic heads then simulated by the regional model. A finer discretized model would be needed to more accurately simulate the hydraulic heads in the proposed well field.

## *Summary*

The proposed North Buttes recharge and recovery site covers about 1,475 acres in the northwestern part of the Lancaster subbasin of the Antelope Valley groundwater basin. The depth to water measured at wells on the site ranges from about 240 ft bls on the western side of the site to about 270 ft bls on the eastern side. Inspection of historical records indicates that water levels have declined about 100 ft in the aquifer beneath the study area since the early 1960s. Groundwater-quality data collected from wells on or near the e proposed site indicate that TDS concentration of samples from wells on the site ranges 260 to 393 mg/L. Four of the eight wells sampled on the site yielded water with arsenic concentrations in excess of the USEPA MCL of 10 μg/L.

The depth to the basement complex (thickness of the basin fill) was estimated in the study area using available regional gravity data. The gravity data indicate that the depth to the basement complex increases from less than 1,000 ft bls on the northeastern side of the site more than 3,000 ft on the western side of the site. Directly west of the site, the gravity data show that the depth to the basement complex increases to more than 7,000 ft bls, suggesting the presence of a northwest-southwest trending fault that has vertically offset the basement complex. South of the site, the gravity data indicate that the depth to the basement complex is less than 100 to 1,000 ft bls, which corresponds to the exposed basement complex in the Antelope and Little Buttes.

The proposed site is located on coalescing alluvial fan deposits derived from the Tehachapi Mountains to the north and the San Gabriel Mountains to the west. Soils on the northern part of the site are predominantly Rosamond soils consisting of loam, silty clay loam, and fine sandy loam that were deposited at the distal end of alluvial fan that extends from the Tehachapi Mountains. Soils on the southern part of the site predominantly are classified as Hesperia and Hanford soils consisting of fine sandy loam to coarse sandy loam deposited on the alluvial fan extending from the San Gabriel Mountains. On the basis of the soil description, about 250 acres of the site are considered to have a good surface-infiltration potential (HkA, HkB, HbA, HbC, and HcA soils), about 500 acres are considered to have a fair surface-infiltration potential (Ro soils), and about 725 acres (Rp and Rt soils) are considered to have limited surface-infiltration potential.

Double-ring infiltrometer tests were completed for this study on the different soil types to more accurately evaluate the potential infiltration rate for the different soils on the site. The infiltrometer test results support the soils property data, and indicate that the sandy loam soils classified as Hesperia (HkA and HkB), Hanford (HbA and HbC), and Rosamond (Ro) soils on the site have fair to good surface infiltration potential; whereas, the loam and silty clay loam soils classified as Rosamond (Rp at Rt) soils on the site have limited surface-infiltration potential. The infiltrometer tests collected at different depths at the same site indicate that the infiltration rates were lower in the deeper tests at the same site in the HkA and Ro soils, about the same in the Rp soil, and higher in the Rt soil.

CPT data were collected at 23 sites to characterize the subsurface lithology to approximately 50 ft or refusal along north-south and east-west trending transects through the proposed site. The CPT data indicate that the percentage of silt and clay deposits is higher beneath the northern part of the site compared to the southern part of the site. Interpolation of the available CPT data indicates the presence of several continuous thin clay layers in the upper 50 ft of the subsurface beneath the northern part of the proposed recharge site. On the basis of the soil description and CPT data, about 385 acres of the 1,475-acre site are considered to have a fair to good surface-infiltration potential and about 1,090 acres are considered to have limited surface-infiltration potential. Undeveloped land in Section 8, directly south of the proposed site, consists of soils that have fair to good surface-infiltration potential. Lithologic data collected adjacent to this property suggests that there are no near-surface clay layers that would inhibit the infiltration of applied water. Adding this land to the proposed recharge and recovery site would significantly increase the recharge potential of the proposed site.

DC resistivity surveys were collected in the project area to help identify geologic structures and potential perching layers. Inverse models of the DC resistivity data along a north-south profile in the eastern part of the site indicate the presence of relatively low-resistivity material from land surface to the water table in the extreme northern part of the site indicating that the northeastern part of the proposed site probably would have limited recharge potential by surface infiltration. Inverse models of the DC resistivity data-along the southeast-northeast profile in the western part of the site indicate the presence of a high-resistivity unit from near land surface to the water table in the southwestern part of the site indicating that the southwestern part of the site probably would have fair to good recharge potential by surface infiltration. The resistivity beneath the northeastern part of the profile is low, indicating that the unsaturated zone is finer grained, and probably has limited potential for recharge by surface infiltration.

Three unsaturated-zone monitoring sites were installed to the water table using the ODEX technique along a north-south profile in the eastern part of the site to determine the lithology and hydraulic properties of the thick unsaturated zone underlying the site. The sites were instrumented to measure the downward movement and quality of existing irrigation return flows and proposed artificial recharge. Borehole data confirmed results of CPT and DC resistivity surveys and indicate that silt and clay are predominant in the unsaturated zone at in the northern part of the site, whereas, sand is predominant in the unsaturated zone at in the southern part of the site. Clay deposits are present in the upper 25 ft of AVUZ-3, in the northern part of the site; however, clay deposits are not present until greater than 60 ft bls at AVUZ-1 and 2, in the southern part of the site. The presence of low-permeability clay in the near subsurface in the northern part of the site would limit the rate and volume of surface infiltration. The predominance of sand and the absence of clay layers in the near subsurface at AVUZ-1 and AVUZ-2 suggest that the southern part of the site would have a greater potential for recharge by surface infiltration than the northern part of the site.

A preliminary, two-dimensional radial flow, multi-phase solute-transport model was developed using TOUGHREACT to test the potential efficacy of artificial recharge at the proposed site. The hydraulic properties within the model were estimated based on lithologic data from test drilling, geophysical log data, CPT data, surface geophysical data, and infiltrometer test results. The model was used to simulate the surface infiltration rate beneath the pond and estimate the time for the infiltrated water to reach the water table at AVUZ-2 in the southern part of the site and AVUZ-3 in the northern part of the site. The model simulates that the surface infiltration rate averages about 0.5 ft/d at AVUZ-2 and less than 0.07 ft/d at AVUZ-3 after two years of artificial recharge. The model simulates that the infiltrated water reaches the water table after about two years of artificial recharge at AVUZ-2; whereas, the model simulates that the infiltrated water only reaches about 80 ft bls at AVUZ_3 after two years.

The unsaturated-zone model results suggest that about 23,000 acre-ft of water could be infiltrated on the 385 acres considered to have fair to good infiltration potential and about 9,000 acre-ft could be infiltrated on the 1,090 acres considered to have limited infiltration potential during a 4-month period. The low permeability clay layers are modeled as continuous layers; therefore, the simulated infiltration rates and time for the recharge to reach the water table probably represent minimum values. A pilot scale recharge project, as proposed in Phase 2 of this study, is needed to determine the long-term infiltration rate and effective groundwater recharge at the two sites. The instrumented unsaturated-zone monitoring sites installed in the eastern part of the site could be used to monitor the vertical migration of the recharge water, if ponds were constructed adjacent to the sites.

The existing USGS Antelope Valley groundwater flow model was updated with data collected from this study and used with particle-tracking software to estimate the effect of artificial recharge on water levels and the movement of water from the site. The updated groundwater-flow model was used to estimate the maximum rate of water that could be recharged at the site while maintaining water levels at least 50 ft bls to prevent liquifaction. Injection was assumed to occur in the winter months (November-February) over five years. The maximum injection rate (recharge) was about 28,500 acre-ft/yr with a total volume of about 142,500 acre-ft. After five years, water levels were simulated to rise about 230 ft at the center of the recharge site. Simulated water-level rises were less than 50 ft within one mile of the site and are less than 10 ft within four miles of the site. MODPATH was used to simulate the groundwater travel times and pathlines for advective transport of the recharge water. The particles on the eastern side of the recharge cell moved a maximum of about 0.75 mile to the east of the site by the end of the five-year simulation period.

The groundwater-flow model was used to simulate the maximum volume of water that could be pumped from the site within one year while not allowing simulated hydraulic heads to decline below hydraulic heads measured on the site prior to the artificial recharge. The model results indicate that about 100,000 acre-ft can be pumped during a 1-year period while meeting the hydraulic-head constraint. Pumpage of 100,000 acre-ft/yr (about 62,000 gpm) would require about 31 wells pumping at a rate of 2,000 gpm. Currently there only are 10 wells on the site, with a combined capacity of less than 33,000 acre-ft/yr (20,000 gpm). Well inefficiencies and well interference would result in lower hydraulic heads then simulated by the regional model. A finer discretized model would be needed to more accurately simulate the hydraulic heads in the proposed well field.

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## *Figures*

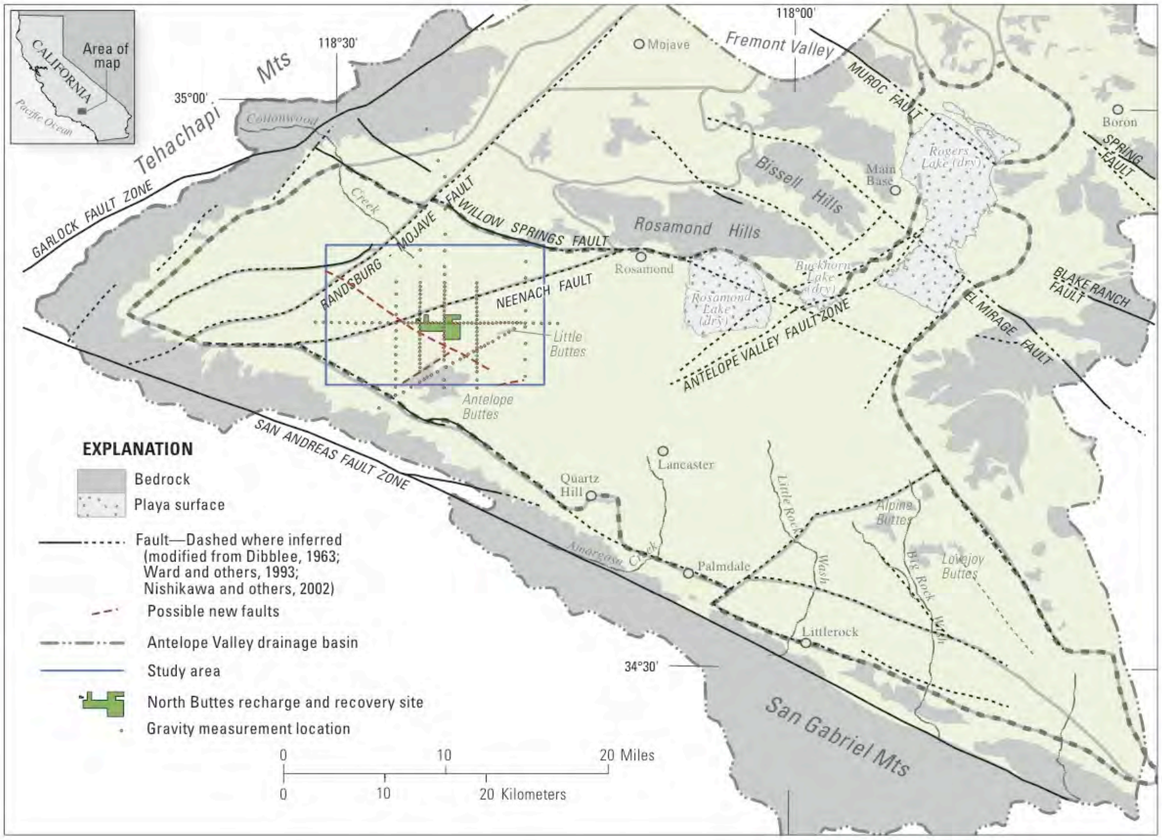



**Figure 1.** Location of study area and gravity measurements.

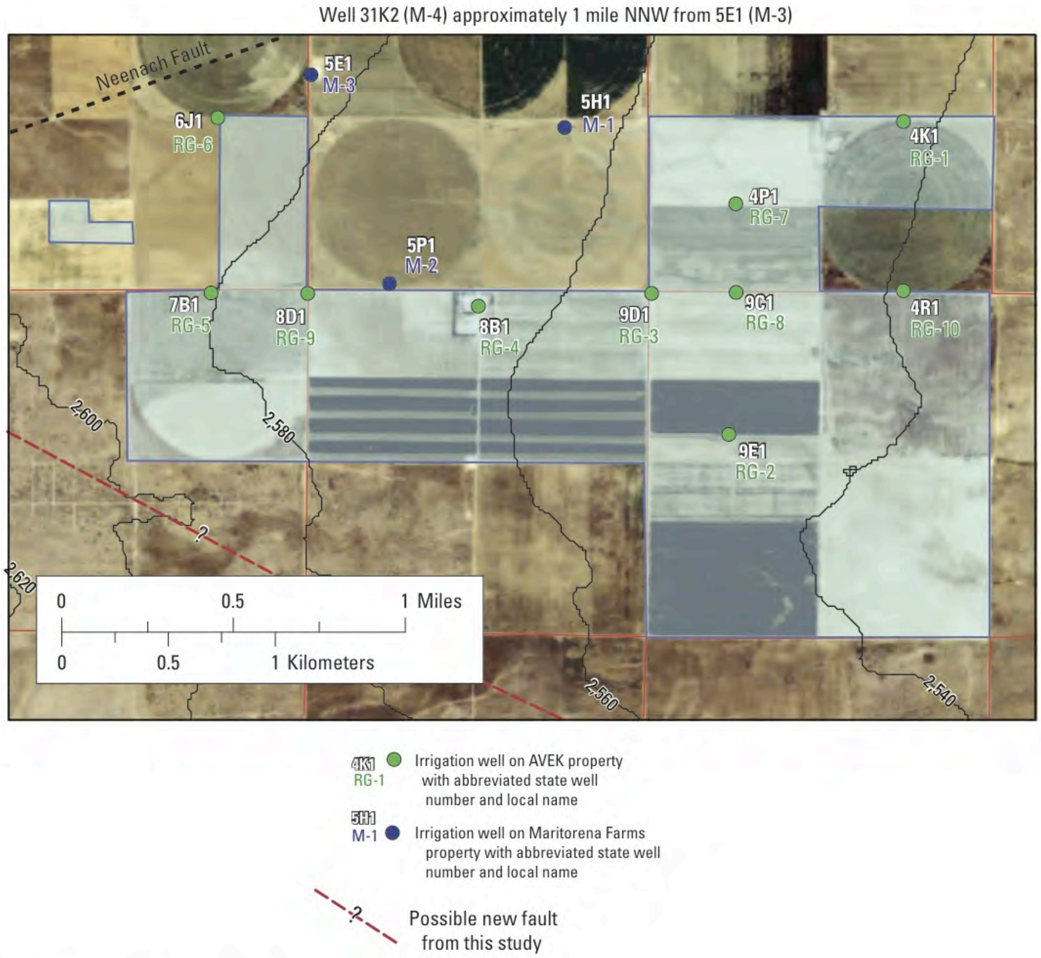



**Figure 2.** Location of irrigation-supply wells in the vicinity of the study area.

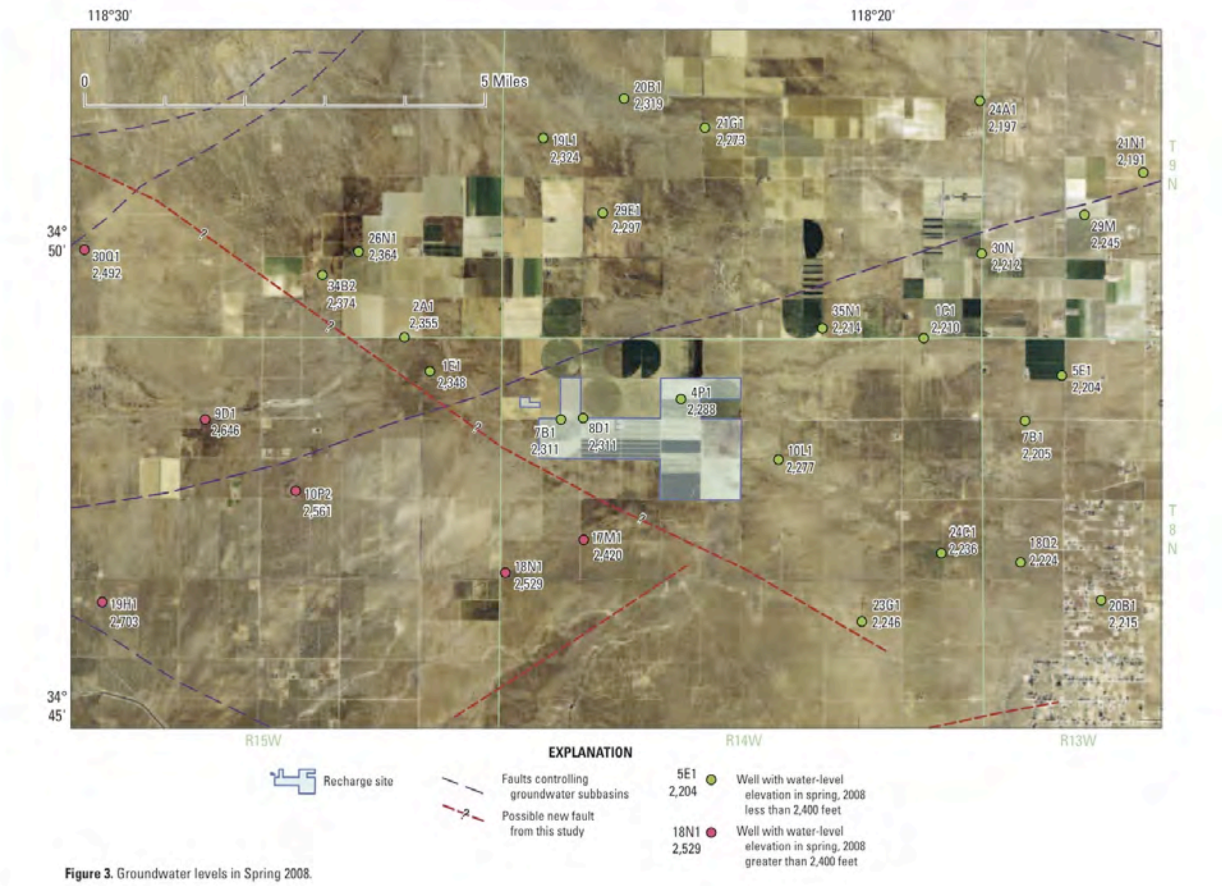



**Figure 3.** Groundwater levels in Spring 2008.

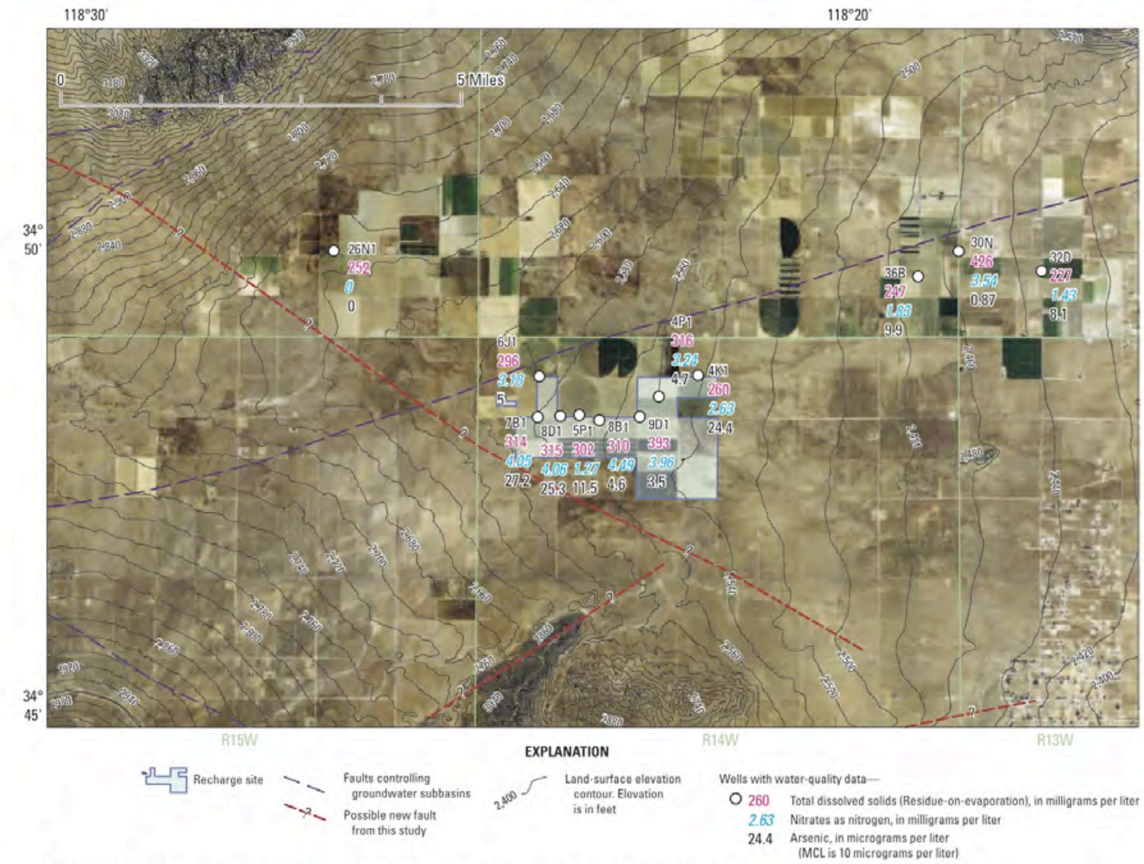



**Figure 4.** Total dissolved solids, nitrate as nitrogen, and arsenic concentration measured in selected wells in the study area.

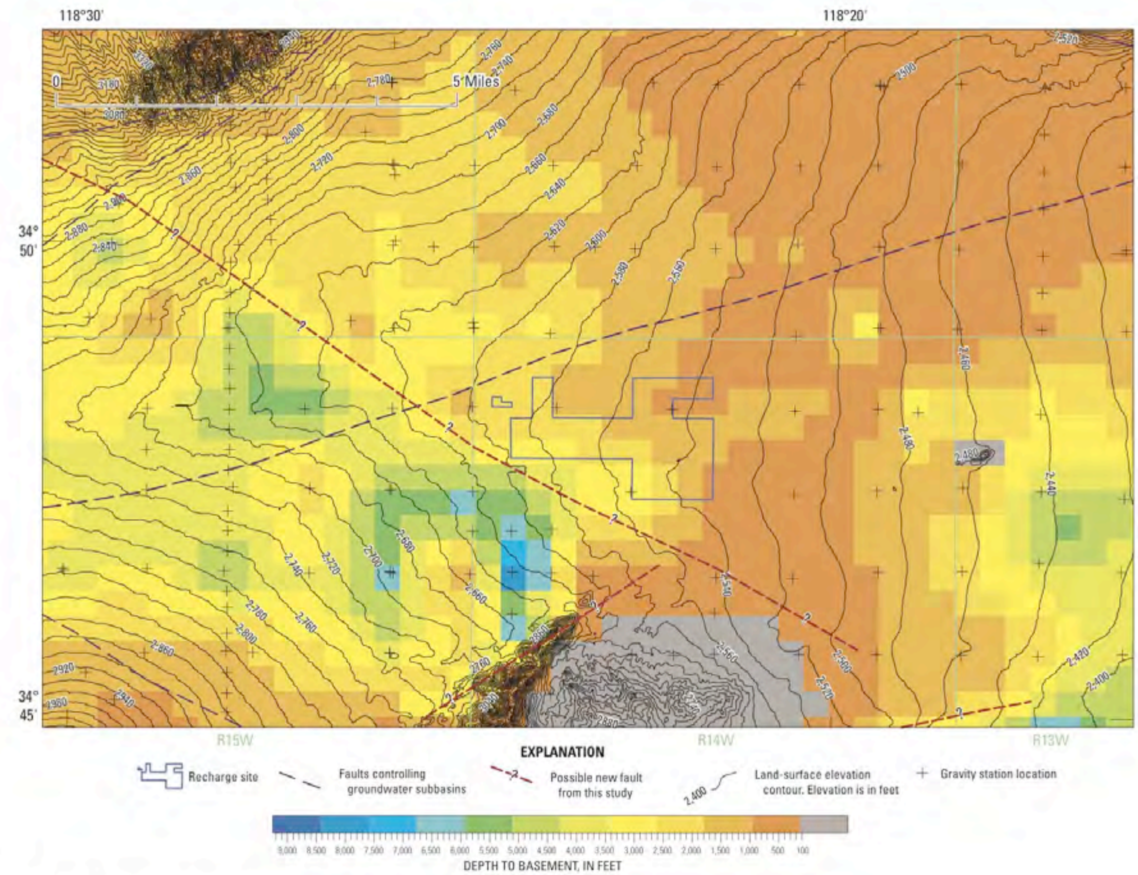
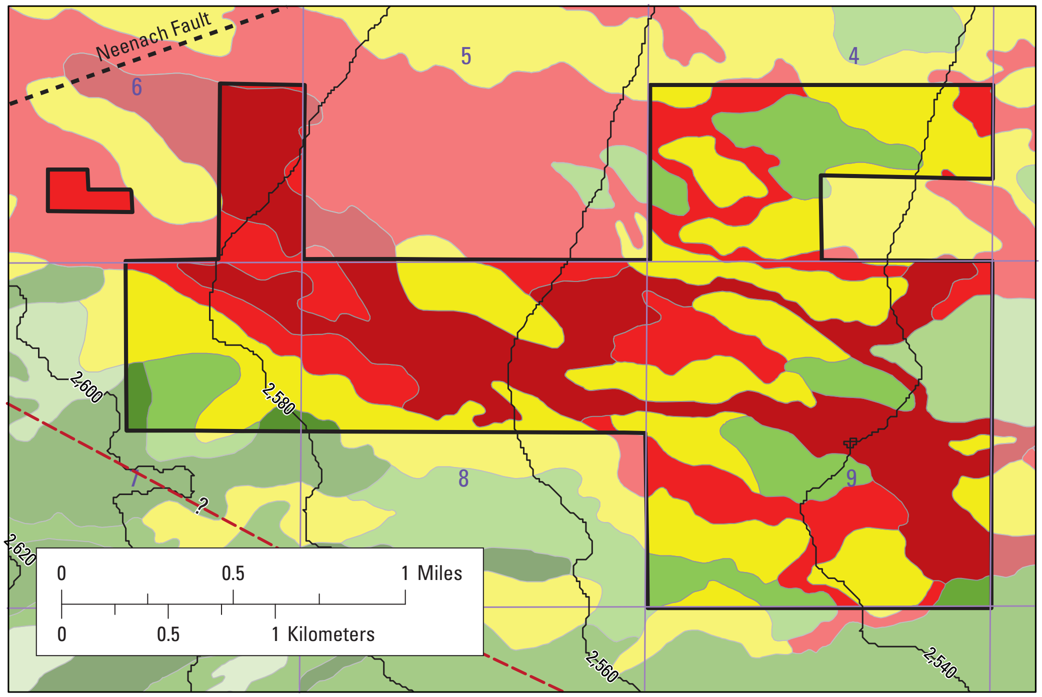


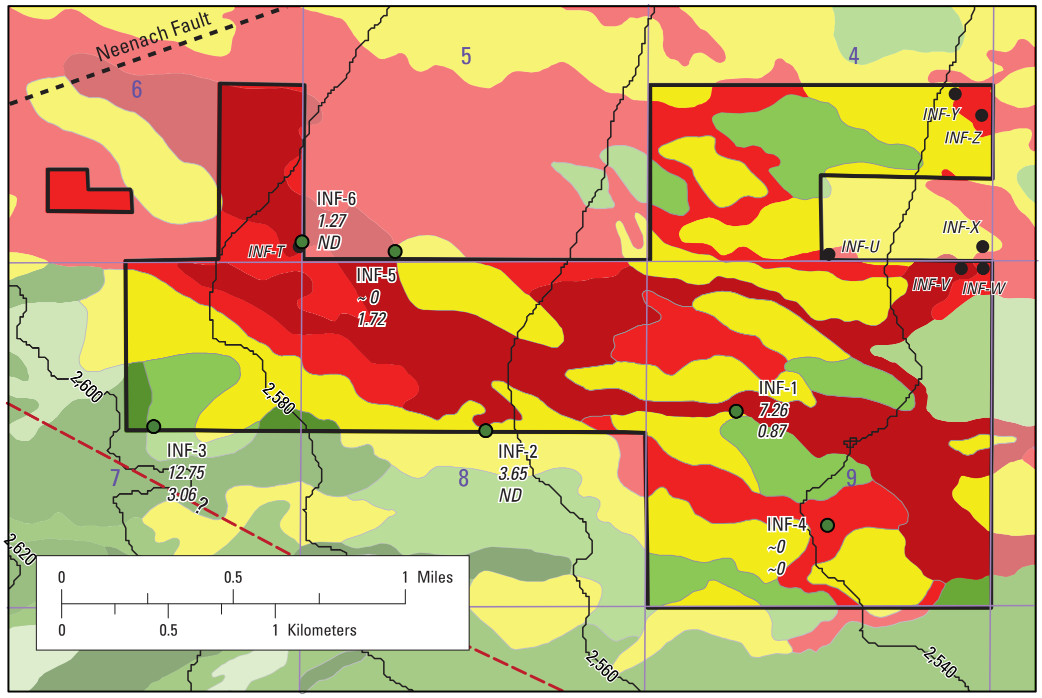

**Figure 5.** Depth to basement complex estimated from gravity measurements.




| Soil Type | Saturated Hydraulic Conductivity | Infiltration Potential | Acres | Total Acres |
|---|---|---|---|---|
| HbA | 7.94 | | ---- | |
| HbC | 7.94 | | 16 | |
| HcA | 7.94 | GOOD | 8 | 248 |
| HkA | 7.94 | | 176 | |
| HkB | 7.94 | | 48 | |
| GsA | | | ---- | |
| Ro | 3.26 | FAIR | 509 | 509 |
| Rp | 2.55 | LIMITED | 315 | 724 |
| Rt | 2.55 | | 409 | |

? Possible new fault from this study

**Figure 6.** Soil types with associated saturated hydraulic conductivity and infiltration potential as defined by the U.S. Department of Agriculture (2009).




| Infiltrometer Site | Soil Type | Surface Infiltration Rate, in feet per day | Infiltration Rate at 3 feet below Surface, in feet per day |
|---|---|---|---|
| 1 | Ro | 7.26 | 0.87 |
| 2 | Ro | 3.65 | ND |
| 3 | HkA | 12.75 | 3.06 |
| 4 | Rp | ~ 0 | ~ 0 |
| 5 | Rt | ~ 0 | 1.72 |
| 6 | Rt | 1.72 | ND |

ND is no data

Black circles indicate sites where test attempted but no data.

? Possible new fault from this study

**Figure 7.** Infiltrometer locations and measured infiltration rates at land surface and three feet below land surface.

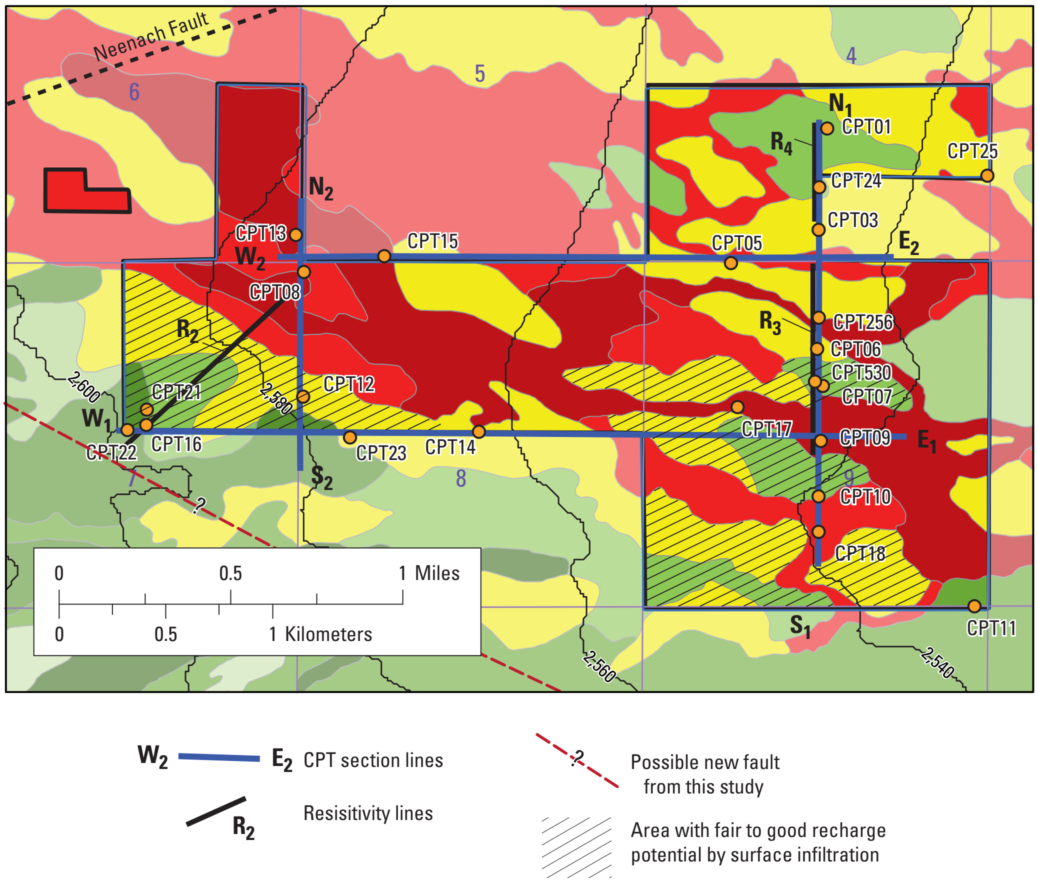



**Figure 8.** Location of Cone Penetration Testing (CPT) sites, geologic sections compiled from CPT data, resistivity lines, and area with fair to good recharge potential by surface infiltration.

(A)

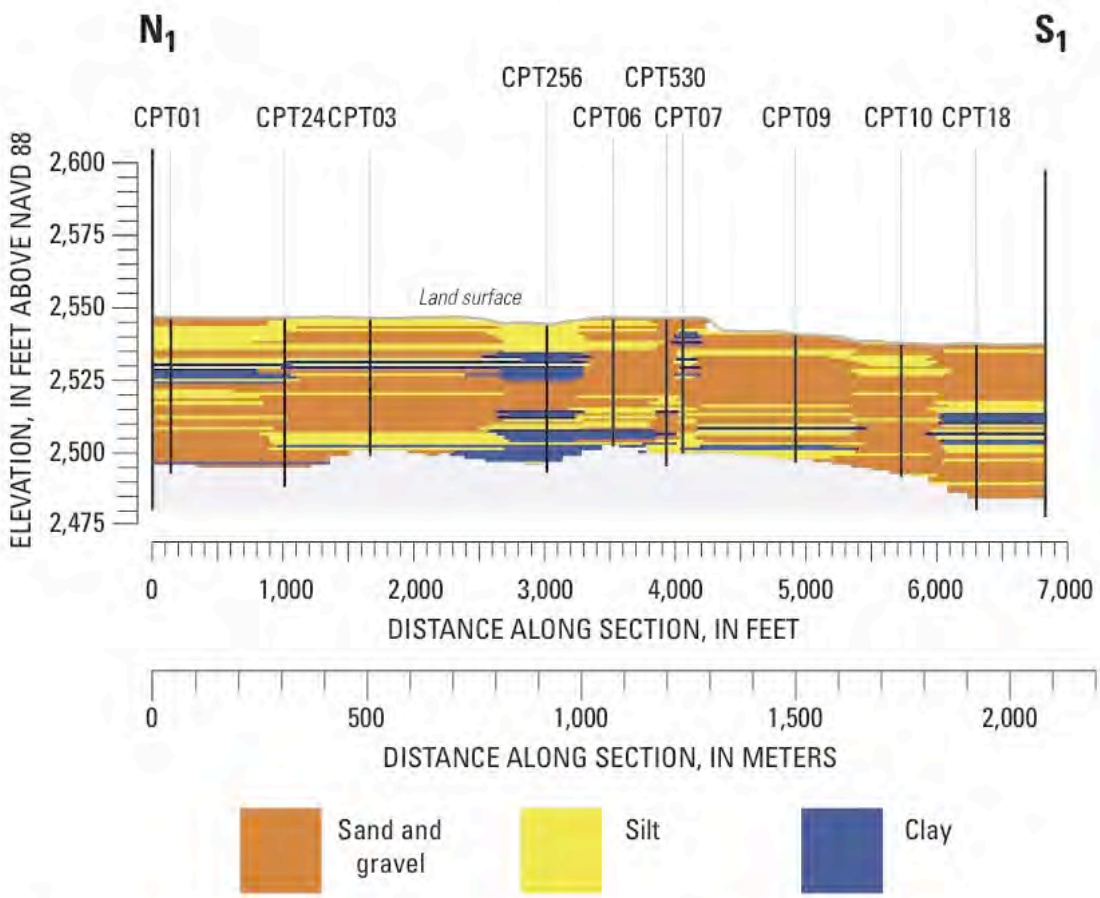
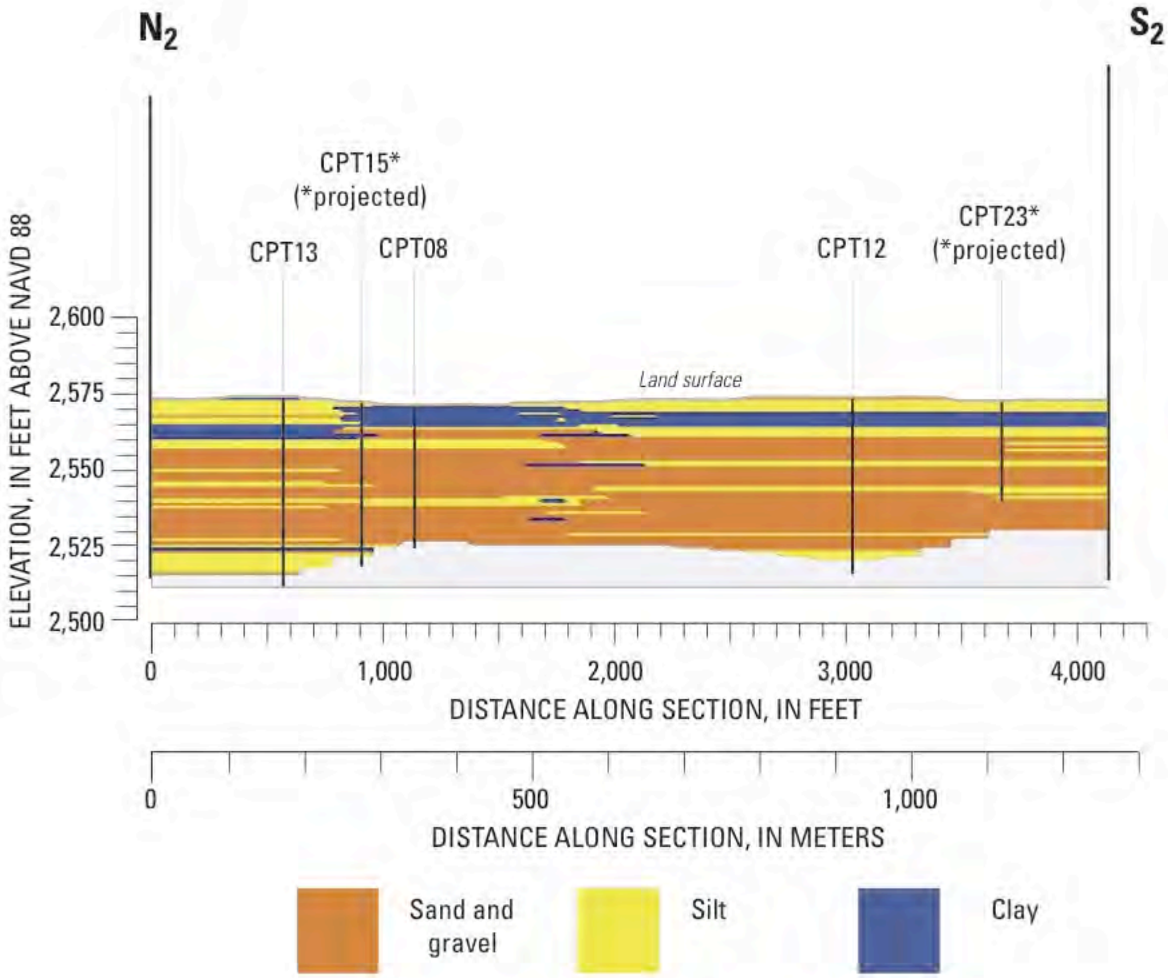
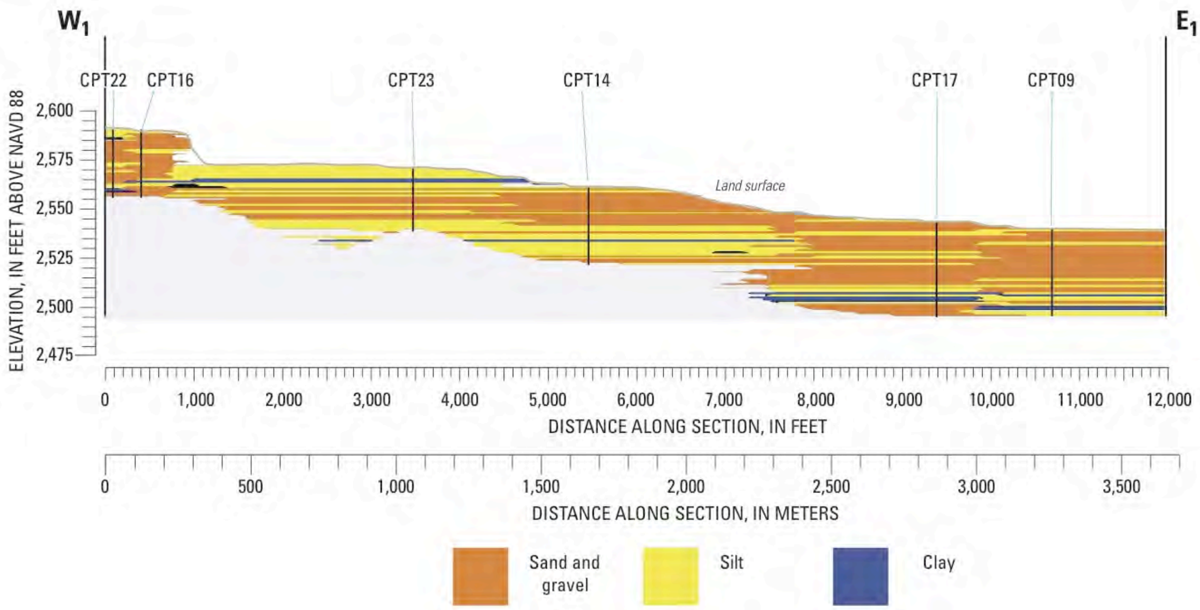



**Figure 9.** Geologic sections based on Cone Penetration Testing (CPT) for (A) $\mathbf{N_1}$-$\mathbf{S_1}$, (B) $\mathbf{N_2}$-$\mathbf{S_2}$ (C) $\mathbf{W_1}$-$\mathbf{E_1}$ and (D) $\mathbf{W_2}$-$\mathbf{E_2}$.

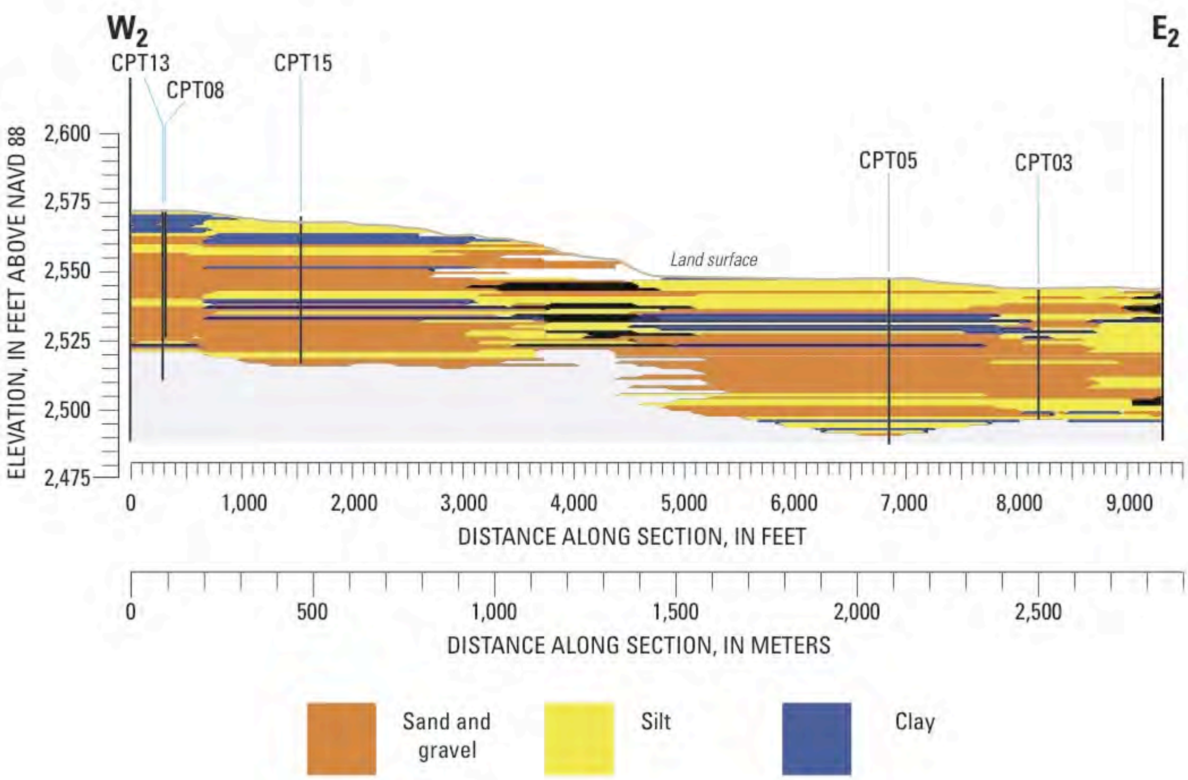
(B)


N2
S2
CPT15*
(*projected)
CPT13
CPT08
CPT12
CPT23*
(*projected)
Land surface
ELEVATION, IN FEET ABOVE NAVD 88
2,600
2,575
2,550
2,525
2,500
0
1,000
2,000
3,000
4,000
DISTANCE ALONG SECTION, IN FEET
0
500
1,000
DISTANCE ALONG SECTION, IN METERS
Sand and gravel
Silt
Clay

(C)


W1
E1
CPT22
CPT16
CPT23
CPT14
CPT17
CPT09
Land surface
ELEVATION, IN FEET ABOVE NAVD 88
2,600
2,575
2,550
2,525
2,500
2,475
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
12,000
DISTANCE ALONG SECTION, IN FEET
0
500
1,000
1,500
2,000
2,500
3,000
3,500
DISTANCE ALONG SECTION, IN METERS
Sand and gravel
Silt
Clay

(D)


W2
E2
CPT13
CPT08
CPT15
CPT05
CPT03
Land surface
ELEVATION, IN FEET ABOVE NAVD 88
2,600
2,575
2,550
2,525
2,500
2,475
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
DISTANCE ALONG SECTION, IN FEET
0
500
1,000
1,500
2,000
2,500
DISTANCE ALONG SECTION, IN METERS
Sand and gravel
Silt
Clay

(A)

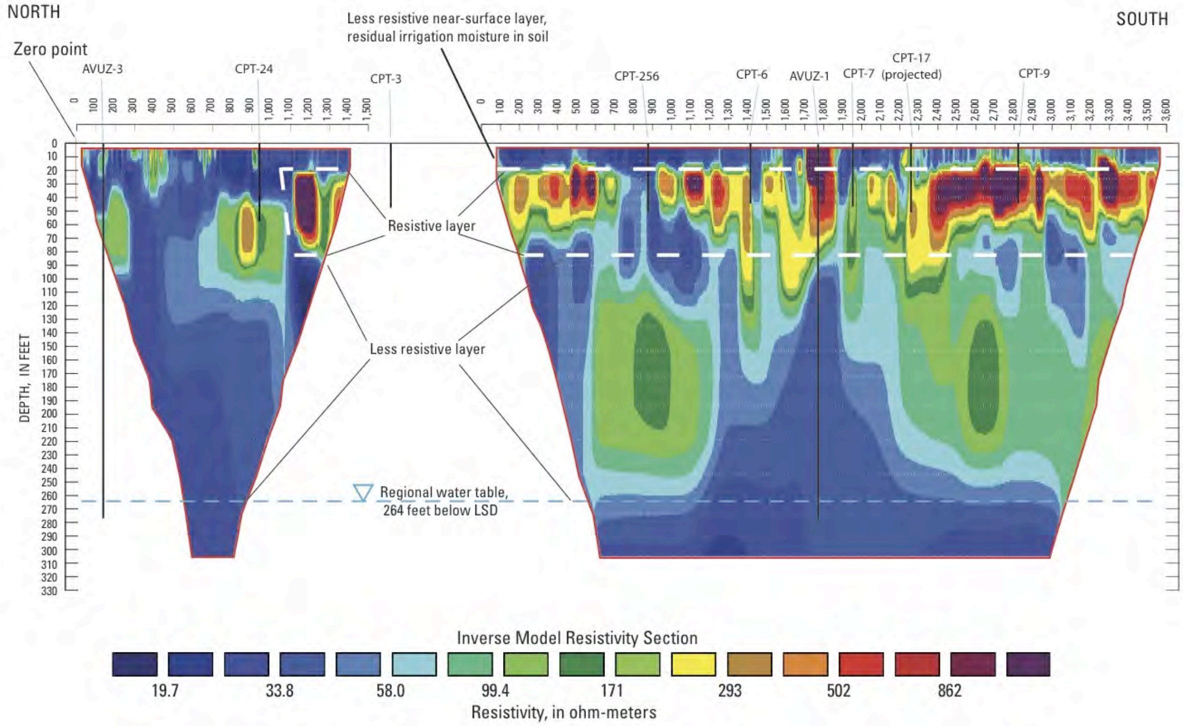
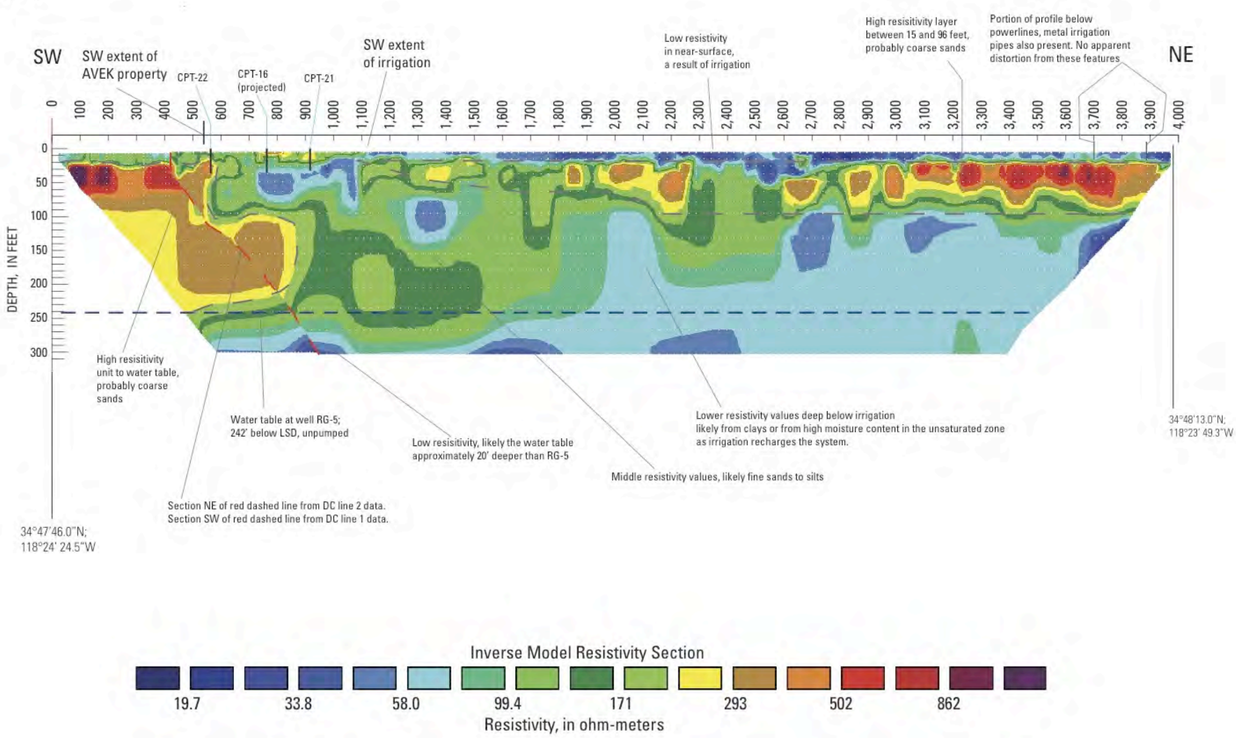
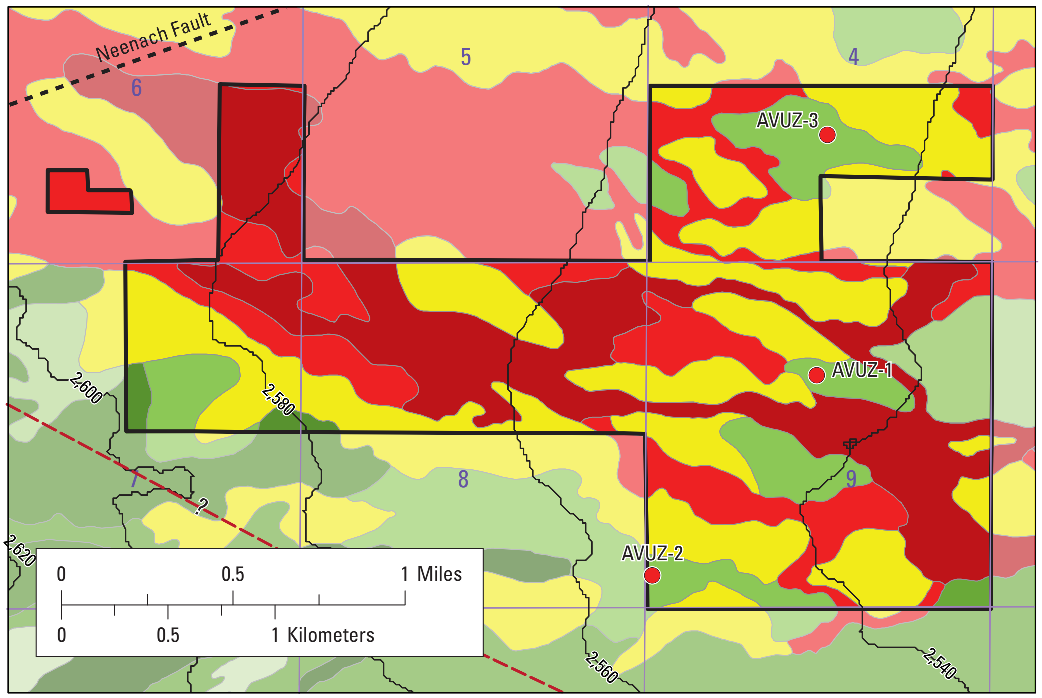



**Figure 10.** Resistivity profile for (A) north-south and (B) southwest-northeast resistivity lines.

(B)






| Soil Type | Saturated Hydraulic Conductivity | Infiltration Potential | Acres | Total Acres |
|---|---|---|---|---|
| HbA | 7.94 | GOOD | ---- | 248 |
| HbC | 7.94 | | 16 | |
| HcA | 7.94 | | 8 | |
| HkA | 7.94 | | 176 | |
| HkB | 7.94 | | 48 | |
| GsA | | | ---- | |
| Ro | 3.26 | FAIR | 509 | 509 |
| Rp | 2.55 | LIMITED | 315 | 724 |
| Rt | 2.55 | | 409 | |

AVUZ-2 Unsaturated zone well and identifier

? Possible new fault from this study

**Figure 11.** Location of unsaturated-zone monitoring sites.

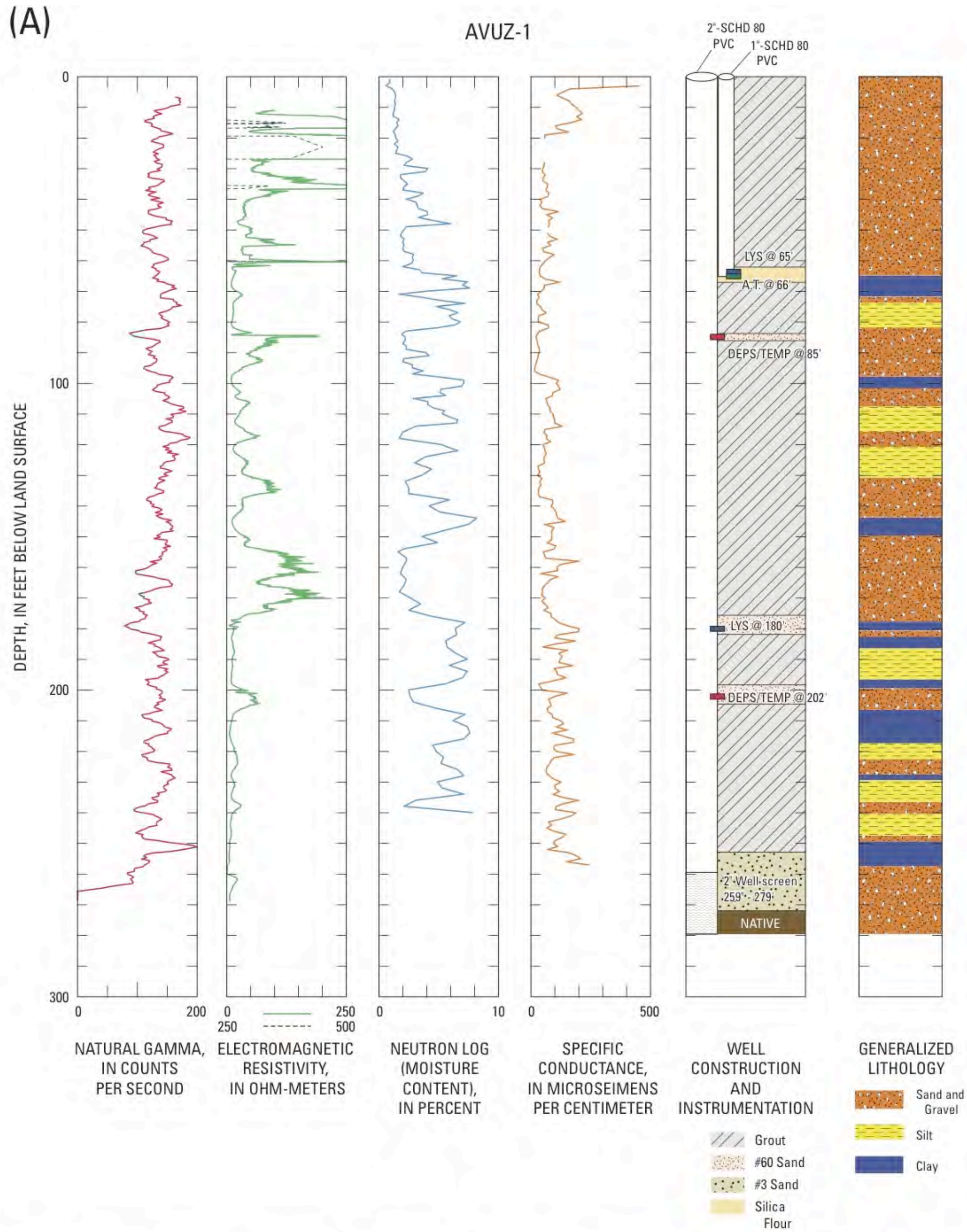
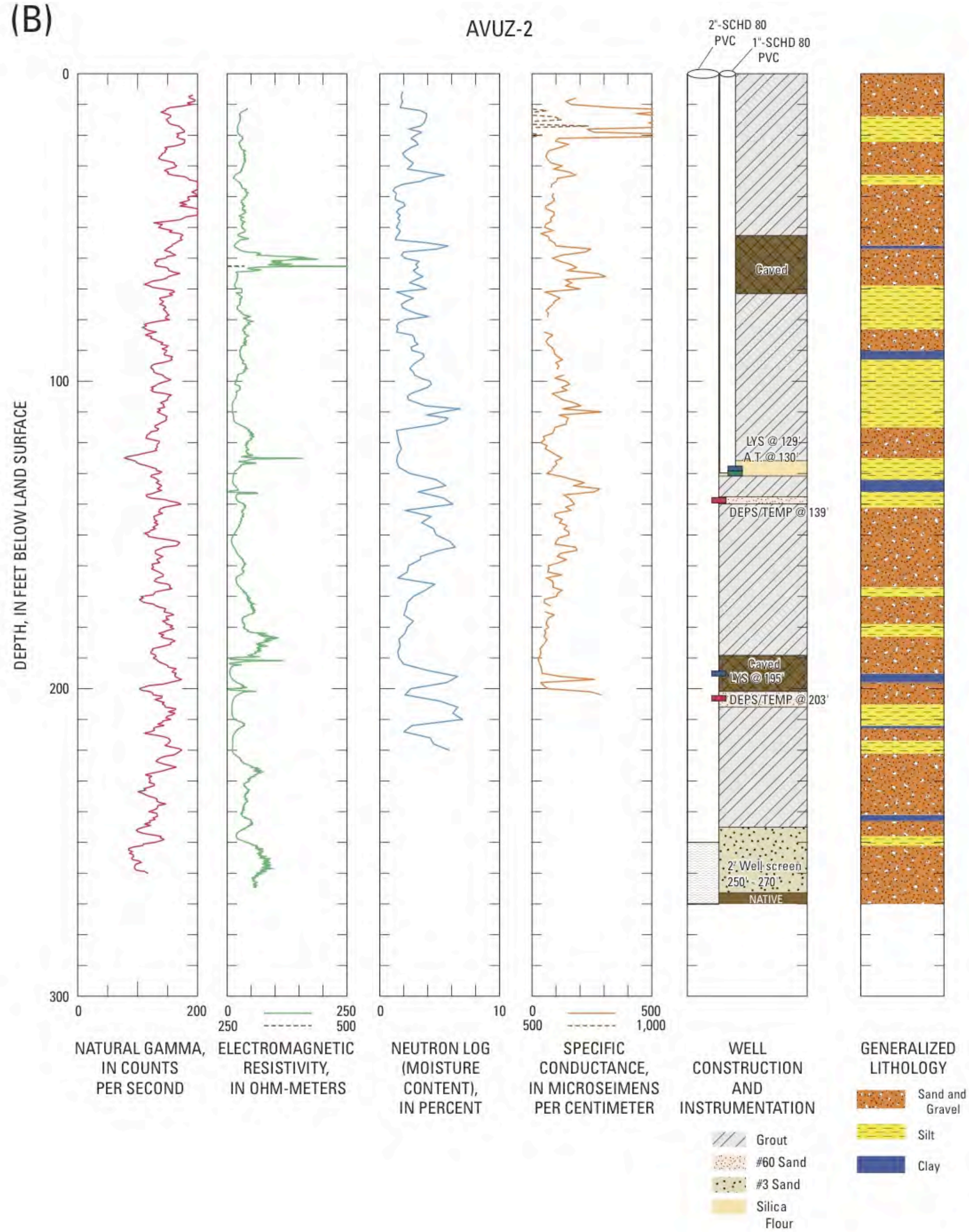
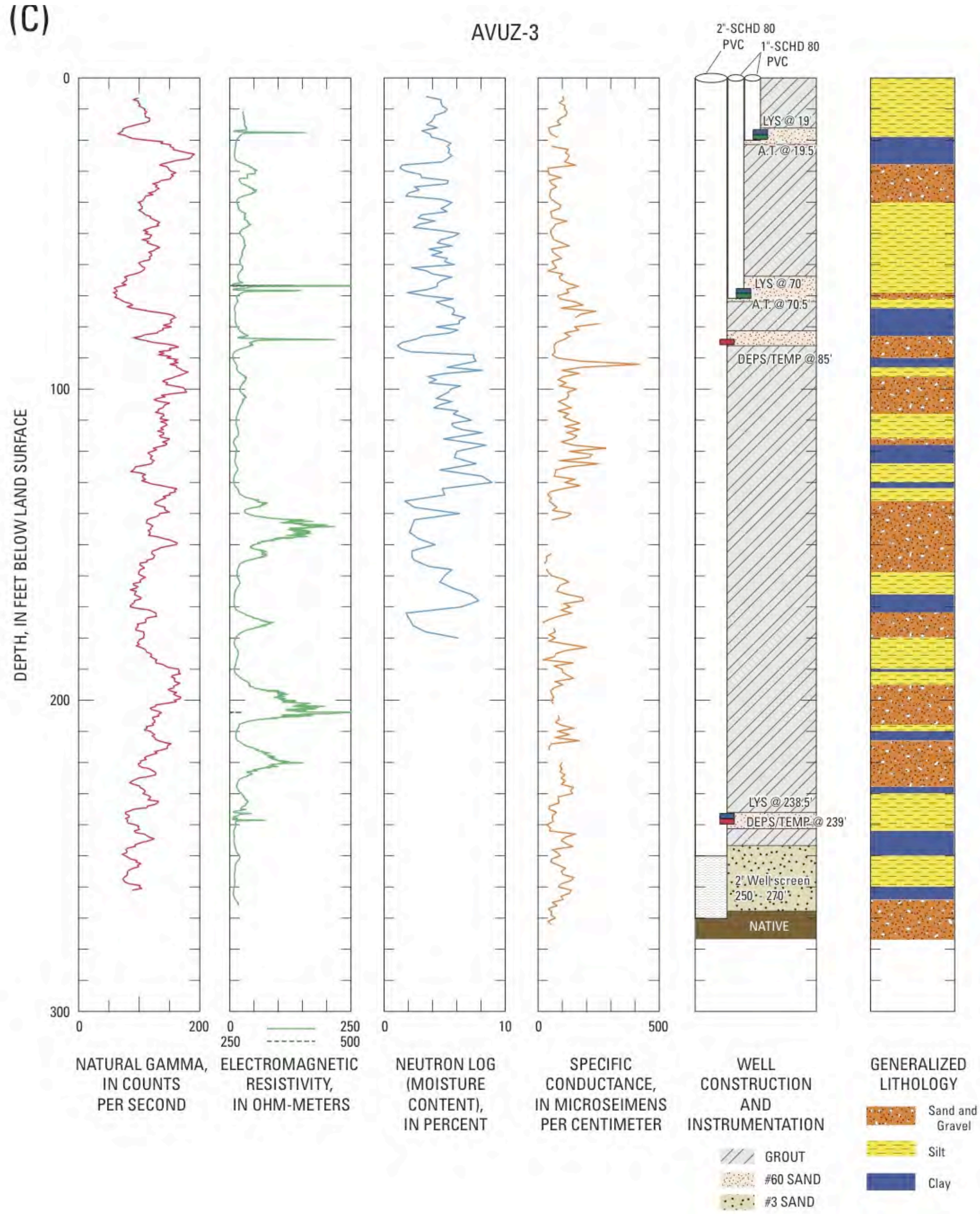



**Figure 12.** Generalized lithology, well construction, instrumentation, natural gamma, electromagnetic resistivity, neutron log (moisture content), and specific conductance for unsaturated-zone monitoring sites (A) AVUZ-1, (B) AVUZ-2, and (C) AVUZ-3.



(B)
AVUZ-2
2"-SCHD 80 PVC
1"-SCHD 80 PVC
DEPTH, IN FEET BELOW LAND SURFACE
0
100
200
300
Caved
LYS @ 129'
A.T. @ 130'
DEPS/TEMP @ 139'
Caved
LYS @ 195'
DEPS/TEMP @ 203'
2" Well screen 250' - 270'
NATIVE
0
200
NATURAL GAMMA, IN COUNTS PER SECOND
0
250
250
500
ELECTROMAGNETIC RESISTIVITY, IN OHM-METERS
0
10
NEUTRON LOG (MOISTURE CONTENT), IN PERCENT
0
500
500
1,000
SPECIFIC CONDUCTANCE, IN MICROSEIMENS PER CENTIMETER
WELL CONSTRUCTION AND INSTRUMENTATION
Grout
#60 Sand
#3 Sand
Silica Flour
GENERALIZED LITHOLOGY
Sand and Gravel
Silt
Clay


(C)
AVUZ-3
2"-SCHD 80 PVC
1"-SCHD 80 PVC
LYS @ 19'
A.T. @ 19.5'
LYS @ 70'
A.T. @ 70.5'
DEPS/TEMP @ 85'
LYS @ 238.5'
DEPS/TEMP @ 239'
2" Well screen 250' - 270'
NATIVE
DEPTH, IN FEET BELOW LAND SURFACE
0
100
200
300
0
200
NATURAL GAMMA, IN COUNTS PER SECOND
0
250
250
500
ELECTROMAGNETIC RESISTIVITY, IN OHM-METERS
0
10
NEUTRON LOG (MOISTURE CONTENT), IN PERCENT
0
500
SPECIFIC CONDUCTANCE, IN MICROSEIMENS PER CENTIMETER
WELL CONSTRUCTION AND INSTRUMENTATION
GROUT
#60 SAND
#3 SAND
GENERALIZED LITHOLOGY
Sand and Gravel
Silt
Clay

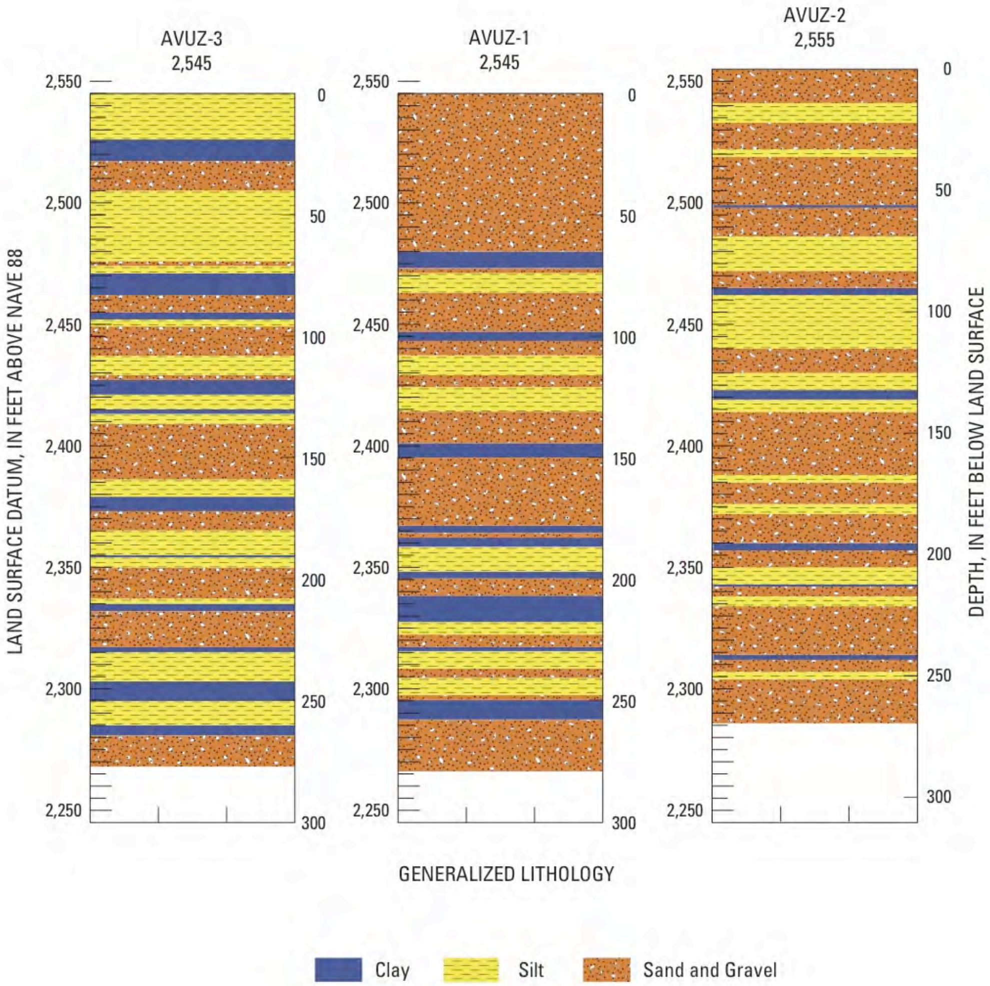



**Figure 13.** Generalized lithology for unsaturated zone monitoring sites (AVUZ-1, AVUZ-2, and AVUZ-3) arranged by altitude along a north-south profile.

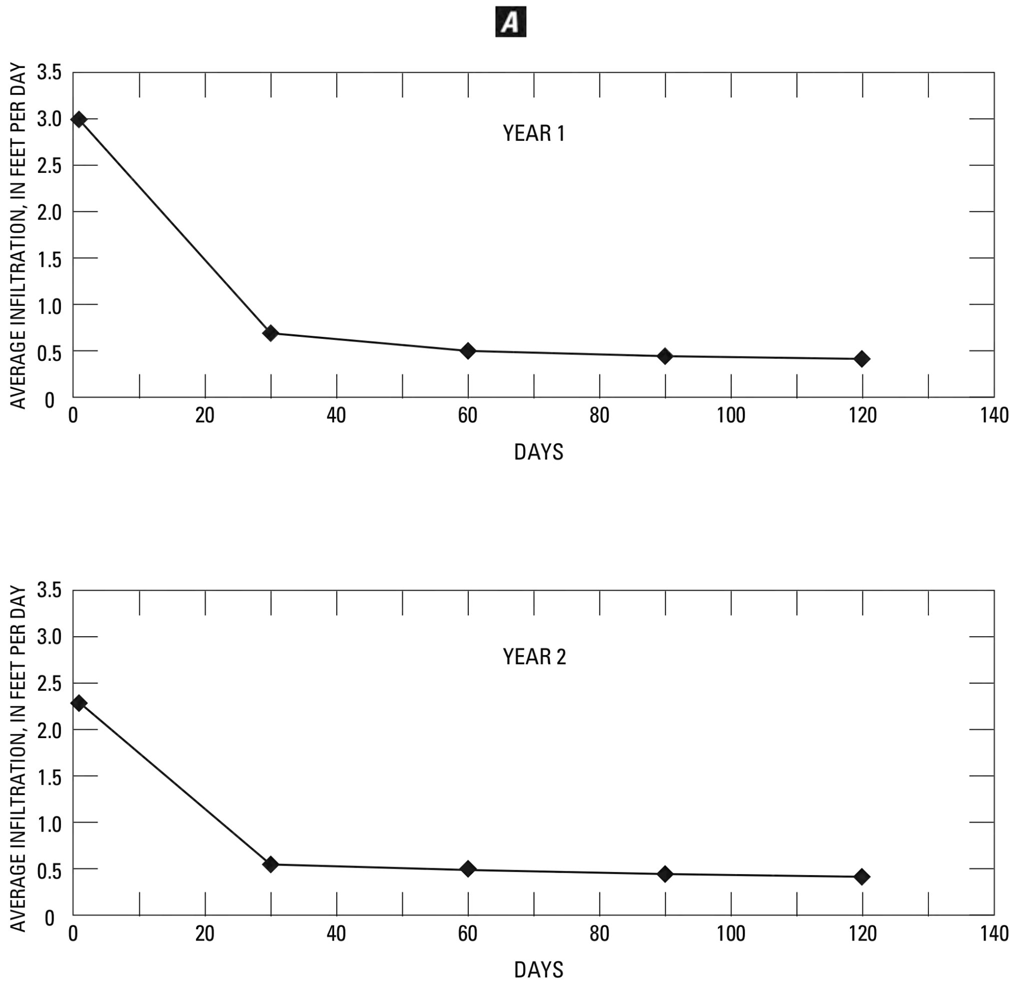



**Figure 14.** Simulated infiltration rates at ***A)*** AVUZ-2 and ***B)*** AVUZ3 after 2 years of recharge.

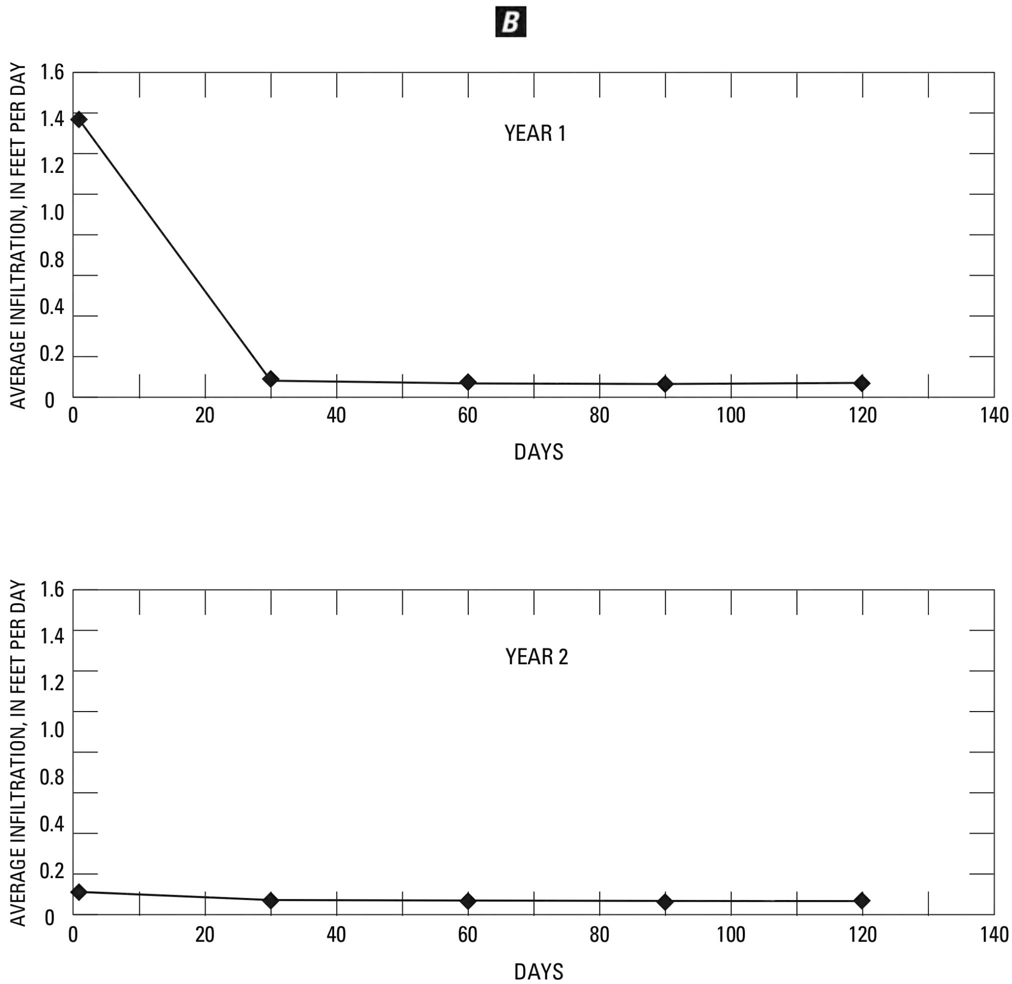



**Figure 14.** Simulated infiltration rates at ***A)*** AVUZ-2 and ***B)*** AVUZ3 after 2 years of recharge.

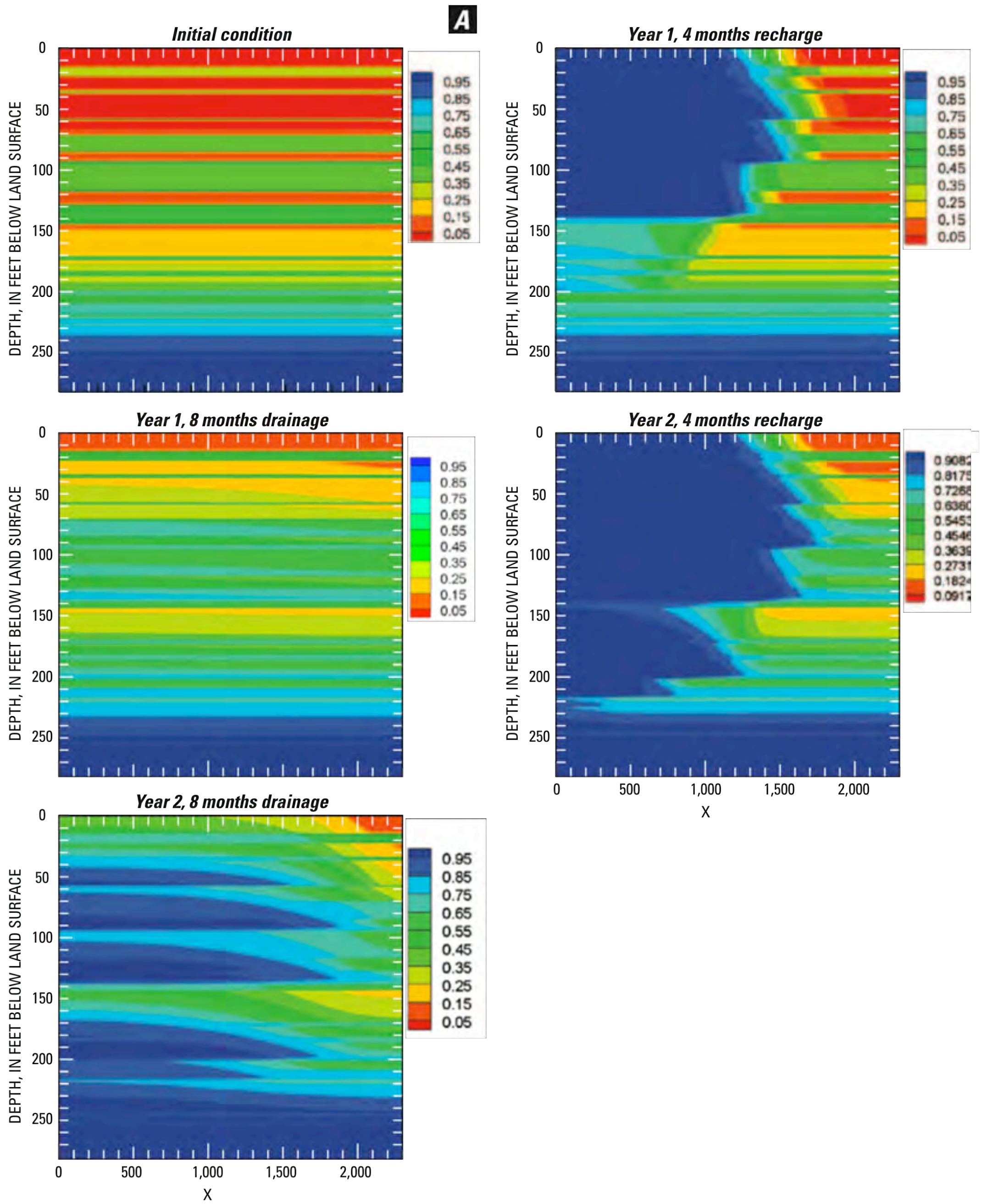



**Figure 15.** Simulated percent saturation at ***A)*** AVUZ-2 and ***B)*** AVUZ3 after 2 years (4 months recharge and 8 months discharge.

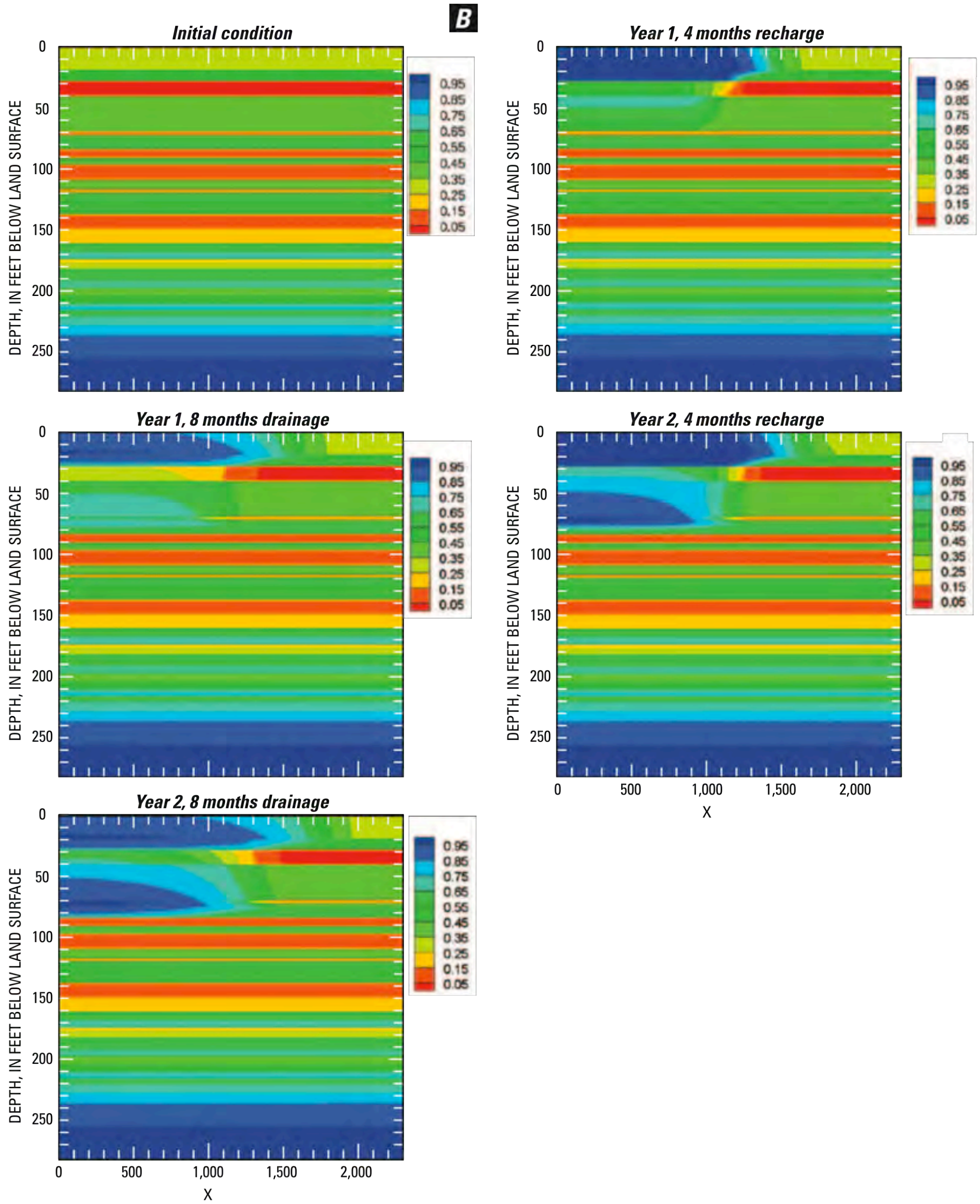



**Figure 15.** Continued

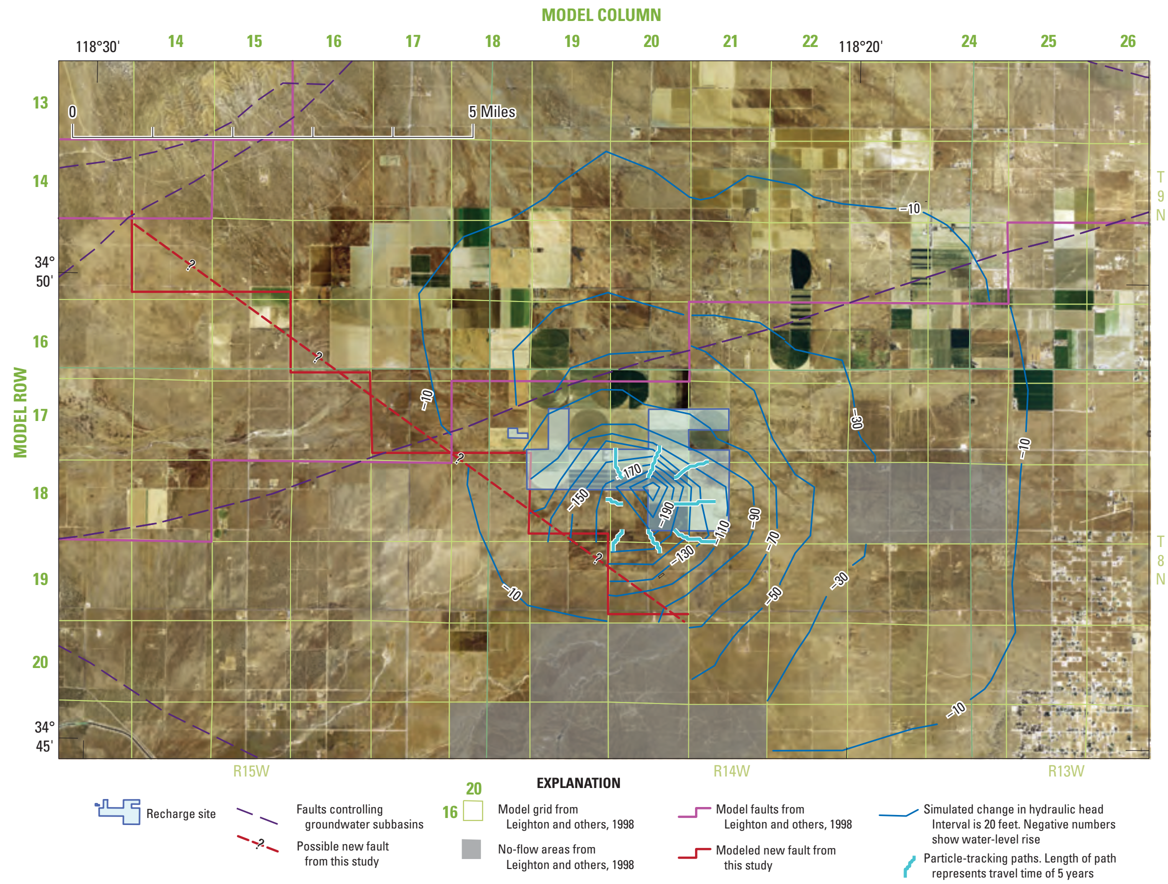



**Figure 16.** Simulated change in hydraulic head and particle-tracking paths after five years of recharging 28,000 acre-feet per year.

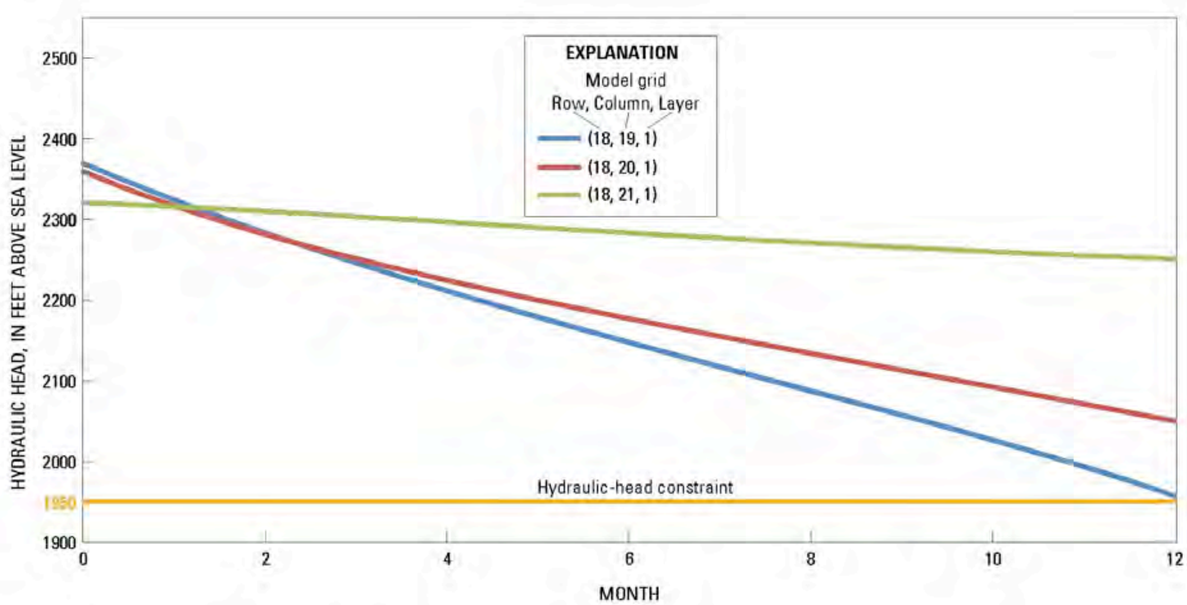



**Figure 17.** Simulated hydraulic head at selected model cells while pumping at a rate of 100,000 acre-feet per year for one year.

## *Tables*

**Table 1.** Well construction information, specific-capacity data, and estimated transmissivity values for selected wells in the study area.

(All depths expressed in feet below land surface except where noted; source of data: USGS, U.S. Geological Survey; DL, drillers log; gpm = gallons per minute; gpm/ft = gallons per minute per foot; ft2/d = square feet per day; ft/d = feet per day; T = Transmissivity)

| State Identification Number | USGS Identification Number | Common Name | Date Drilled | Land surface elevation (feet) | Well depth | Top of Screen | Bottom of Screen | Initial Water Level | | Recent Water Level | | Specific capacity | T | Specific capacity data source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Date | Depth | Date | Depth | (gpm/ft) | (f^2/d) | |
| 008N014W04K001S | 344843118215601 | RG-1 | 1963 | 2,542 | 654 | 254 | 654 | 1963 | 187 | -- | -- | -- | -- | DL |
| 008N014W04P001S | 344829118222801 | RG-7 | -- | 2,550 | -- | -- | -- | -- | -- | -- | -- | -- | -- | DL |
| 008N014W04R001S | 344816118215701 | RG-10 | 1969 | 2,534 | 565 | 282 | 564 | 1969 | 255 | -- | -- | 90 | 20,700 | DL |
| 008N014W05E001S | 344849118234301 | M3 | 1961 | 2,579 | 600 | 300 | 600 | 5/1/62 | 183.1 | -- | -- | 98 | 22,500 | DL |
| 008N014W05H001S | 344842118225601 | M1 | 1962 | 2,561 | 706 | 300 | 706 | 2/19/63 | 179.72 | -- | -- | 111 | 25,400 | DL |
| 008N014W05P001S | 344817118233101 | M2 | -- | 2,571 | -- | -- | -- | -- | -- | -- | -- | -- | -- | DL |
| 008N014W06J001S | 344841118240301 | RG-6 | 1974 | 2,586 | 680 | 280 | 680 | 1974 | 290 | -- | -- | 29 | 6,570 | DL |
| 008N014W07B001S | 344815118240401 | RG-5 | -- | 2,580 | -- | -- | -- | -- | -- | 7/22/2009 | 242 | 20 | 4,600 | USGS |
| 008N014W08B001S | 344814118231101 | RG-4 | 1968 | 2,565 | 1,100 | 437 | 1,037 | 5/28/58 | 175 | -- | -- | 20 | 4,600 | DL |
| 008N014W08D001S | 344815118234601 | RG-9 | 1963 | 2,573 | 593 | 247 | 536 | 1963 | 185 | -- | -- | 40 | 9,200 | DL |
| 008N014W09C001S | 344816118222801 | RG-8 | 1966 | 2,550 | 565 | 260 | 565 | 1966 | 219 | 10/23/09 | 274.00 | 48 | 11,000 | DL |
| 008N014W09D001S | 344816118224001 | RG-3 | 1964 | 2,556 | 640 | 240 | 640 | 1964 | 186 | -- | -- | 65 | 14,800 | DL |
| 008N014W09E001S | 344755118222901 | RG-2 | -- | 2,550 | -- | -- | -- | -- | -- | 10/26/09 | 273.02 | -- | -- | DL |
| 009N014W31K002S | 344929118241701 | M4 | 1980 | 2,604 | 600 | 300 | 600 | 2/19/63 | 229.16 | -- | -- | -- | -- | DL |

**Table 2.** Measured saturated hydraulic conductivity of core samples and ponded infiltration rates at selected sites in the study area.

[Analysis Method:duplicate analyses are noted as Run 1 and Run2; infitration tests consisted of an infiltrometer test conducted at land surface and/or at about 4 feet below land surface. ft/d = feet per day. All depths expressed in feet below land surface datum.]

| Location | Surficial Soil Type | Generalized Lithology | Analysis Method | Depth Below Land Surface (feet) | Saturated Hydraulic Conductivity (ft/d) | Ponded Infiltration Rate at Land Surface (ft/d) | Ponded Infiltration Rate at 4 feet below Land Surface (ft/d) |
|---|---|---|---|---|---|---|---|
| INF1 | Ro | sand | Infiltration Test | -- | -- | 7.26 | 0.87 |
| | | sand | Permeameter | 1 | 1.0827 | -- | -- |
| INF2 | Ro | sand | Infiltration Test | -- | -- | 3.65 | -- |
| INF3 | HkA | sand | Infiltration Test | -- | -- | 12.75 | 3.06 |
| | | sand | Permeameter | 3 | 0.984 | -- | -- |
| | | sand | Permeameter (Run 1) | 3.5 | 2.953 | -- | -- |
| | | sand | Permeameter (Run 2) | 3.5 | 3.051 | -- | -- |
| INF4 | Rp | clay | Infiltration Test | -- | -- | ~0 | ~0 |
| INF5 | Rt | clay | Infiltration Test | -- | -- | ~0 | 1.72 |
| | | clay | Permeameter | 0.5 | 0.030 | -- | -- |
| INF6 | Rt | silt | Permeameter | 6 | 0.656 | 1.72 | -- |
| CPT-1 | HkA | clay | Permeameter | 17.6 | 0.020 | -- | -- |
| CPT-11 | HkA | clay | Permeameter | 12.6 | 0.002 | -- | -- |
| CPT-24 | Hka | sand | Permeameter | 7.1 | 0.951 | -- | -- |
| CPT-256 | Ro | silt | Permeameter | 1.5 | 0.003 | -- | -- |
| CPT-530 | HkA | silt | Permeameter | 6.9 | 0.0003 | -- | -- |
| | | silt | Permeameter | 7.7 | 0.0026 | -- | -- |
| AVUZ-2 | HkA | silt | Permeameter (Run 1) | 82.5 | 0.240 | -- | -- |
| | | silt | Permeameter (Run 2) | 82.5 | 0.225 | -- | -- |
| | | silt | Permeameter | 102.0 | 0.483 | -- | -- |
| AVUZ-3 | HkA | silt | Permeameter (Run 1) | 72.5 | 0.353 | -- | -- |
| | | silt | Permeameter (Run 2) | 72.5 | 0.315 | -- | -- |
| | | clay | Permeameter (Run 1) | 73.0 | 0.018 | -- | -- |
| | | clay | Permeameter (Run 2) | 73.0 | 0.015 | -- | -- |

**Table 3.** Location and characteristics of unsaturated-zone monitoring sites.

[All depths expressed in feet below land surface datum except where noted. Instrument PIEZ, 2-inch piezometer, DEPS, dielectric permittivity sensor, TEMP, temperature Sensor, LYS, suction-cup lysimeter, A.T., advanced tensiometer]

| Site | USGS Identification Number | State Identification Number | Land Surface Elevation (feet) | Depth Drilled | Depth to Water | | Instrumentation | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Depth | Date | Instrument | Depth |
| **AVUZ-1** | 344800118221308 | 008N/014W-09F003SLYS | 2,545 | 279 | 262 | 10/31/13 | LYS | 65 |
| | 344800118221307 | -- | | | | | A.T. | 66 |
| | 344800118221306 | | | | | | TEMP | 85 |
| | 344800118221305 | -- | | | | | DEPS | 85 |
| | 344800118221304 | 008N/014W-09F002SLYS | | | | | LYS | 180 |
| | 344800118221303 | -- | | | | | TEMP | 202 |
| | 344800118221302 | -- | | | | | DEPS | 202 |
| | 344800118221301 | 008N/014W-09F001S | | | | | PIEZ | 259 - 279 |
| **AVUZ-2** | 344729118224308 | 008N/014W-09W003SLYS | 2,555 | 270 | 259 | 11/5/13 | LYS | 129 |
| | 344729118224307 | -- | | | | | A.T. | 130 |
| | 344729118224306 | -- | | | | | TEMP | 139 |
| | 344729118224305 | -- | | | | | DEPS | 139 |
| | 344729118224304 | 008N/014W-09W002SLYS | | | | | LYS | 195 |
| | 344729118224303 | -- | | | | | TEMP | 203 |
| | 344729118224302 | -- | | | | | DEPS | 203 |
| | 344729118224301 | 008N/014W-09W001S | | | | | PIEZ | 250 - 270 |
| **AVUZ-3** | 344836118221110 | 008N/014W-04K005SLYS | 2,545 | 273 | 264 | 11/11/13 | LYS | 19 |
| | 344836118221109 | -- | | | | | A.T. | 19.5 |
| | 344836118221108 | 008N/014W-04K004SLYS | | | | | LYS | 70 |
| | 344836118221107 | -- | | | | | A.T. | 70.5 |
| | 344836118221106 | -- | | | | | TEMP | 85 |
| | 344836118221105 | -- | | | | | DEPS | 85 |
| | 344836118221104 | 008N/014W-04K003SLYS | | | | | LYS | 238.5 |
| | 344836118221103 | -- | | | | | TEMP | 239 |
| | 344836118221102 | -- | | | | | DEPS | 239 |
| | 344836118221101 | 008N/014W-04K002S | | | | | PIEZ | 250-270 |

# Attachment 3 Exhibit
# 10% Conceptual Design Drawings (Sheets 1 – 9)

PRELIMINARY
10% DESIGN

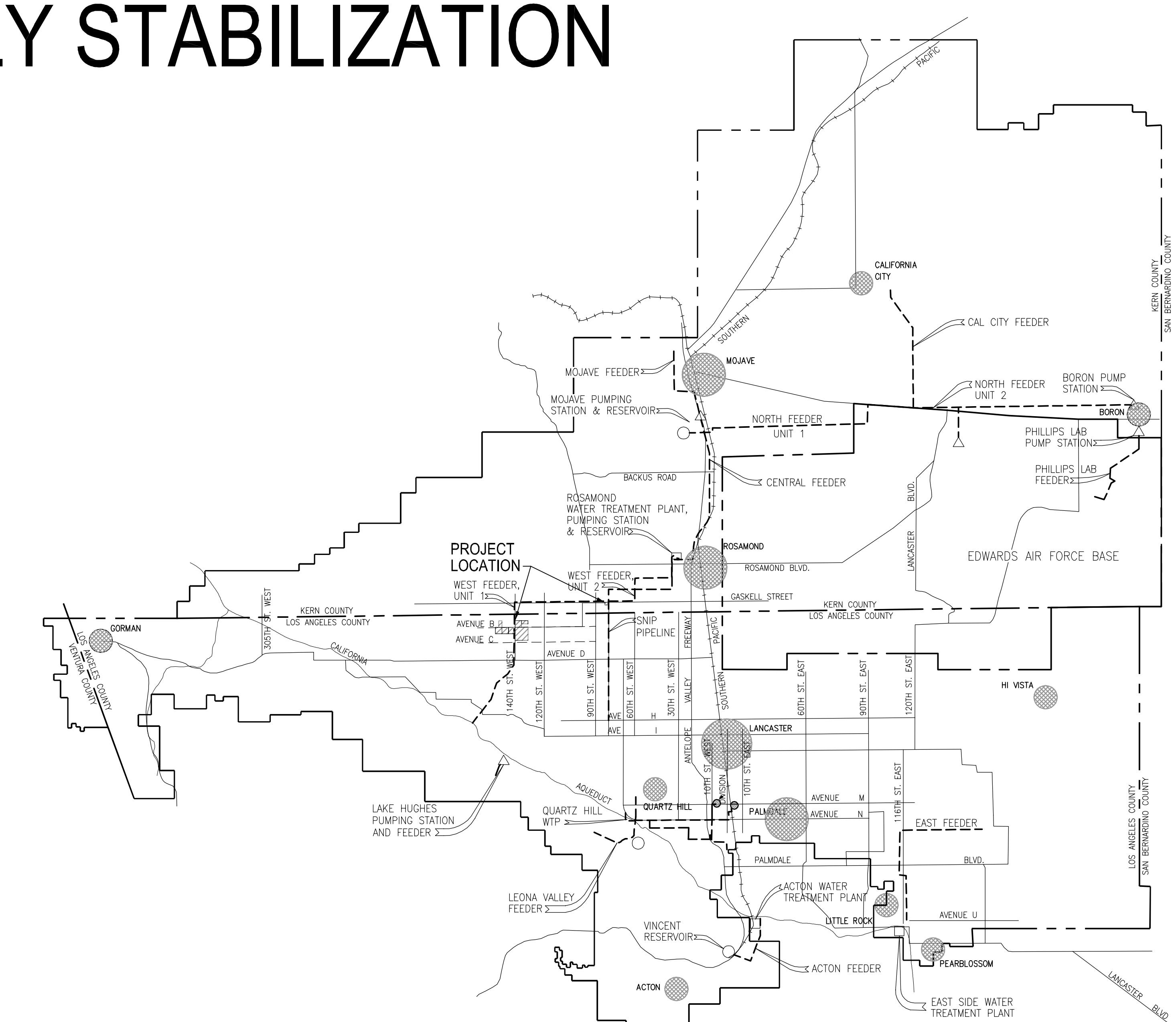
CONSTRUCTION PLANS FOR:

# ANTELOPE VALLEY-EAST KERN WATER AGENCY

## WATER SUPPLY STABILIZATION PROGRAM - 2

JANUARY 2011

APPROVED, AVEK
BOARD OF DIRECTORS,

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A PUBLIC AGENCY

PROJECT

WATER SUPPLY STABILIZATION PROGRAM - 2

PROJECT MANAGER - DATE

PROJECT ENGINEER - DATE

| ACCOUNT NUMBER | FILE NUMBER |
|---|---|
| 60182837 | S-2468 |

| SHEET NUMBER | OF | SHEETS |
|---|---|---|
| 1 | | - |

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DWG: S:\A01\60182837-WSSP 2-Grant Application\CAD\Planset\S2468 G-01.dwg USER: campbellv
DATE: Dec 21, 2010 10:35am XREFS:

## SHEET INDEX

| SHT. | DWG. | SHEET TITLE |
|---|---|---|
| 1 | G-01 | TITLE SHEET AND LOCATION MAP |
| 2 | G-02 | SHEET INDEX AND CONSTRUCTION NOTES |
| 3 | G-03 | PROJECT MAP |
| 4 | C-01 | RECHARGE BASIN PLAN |
| 5 | C-02 | RECHARGE PIPELINES |
| 6 | C-03 | WELL FIELD COLLECTOR PIPELINES |
| 7 | C-04 | WELL FIELD PIPELINES |
| 8 | C-05 | PUMP STATION SITE PLAN |
| 9 | C-06 | PUMP STATION EXTERIOR ELEVATIONS |

## AGENCIES EXERCISING RESPONSIBILITY FOR SERVICES.

WATER
ANTELOPE VALLEY–EAST KERN WATER AGENCY..........1–661–943–3201

TELEPHONE
AT&T..........................................................................1–818–373–5068

ELECTRIC
SOUTHERN CALIFORNIA EDISON....................................1–800–635–4555

USA
UNDERGROUND SERVICE ALERT....................................1–800–422–4133

## BASIS OF BEARING:

THE BEARING N 88° 49' 47" E (N 88° 41' 06" E PER TRACT MAP 5092, PHASE I AS RECORDED IN BOOK 37 AT PAGE 120 OF MAPS), BEING THE CENTERLINE OF FELSITE AVENUE AND ALSO BEING THE NORTH LINE OF THE SOUTHEAST QUARTER OF SECTION 18, TOWNSHIP 9 NORTH, RANGE 12 WEST, S.B.B.&M. KERN COUNTY, CA. WAS ESTABLISHED AS THE BASIS FOR ALL BEARINGS FOR THIS PROJECT.

## AERIAL VERTICAL CONTROL

SOURCE: L.A. DEPARTMENT OF PUBLIC WORKS
BENCH LIST: LANCASTER QUAD
DATUM: NAVD 88–ADJUSTED 2004
PROJECT BENCHMARK: L.A. COUNTY B.M. NO. 2244, LOCATED AT THE S.E. CORNER OF AVENUE A AND 60th STREET WEST. MARK IS 3 1/2–INCH BRASS DISK SET IN CONCRETE. ELEVATION: 2383.45–FEET. PROJECT POINT NO. 511.

## PROJECT BENCH MARK"

L.A. COUNTY B.M. NO. 6434 LOCATED AT THE N.W. CORNER OF AVENUE G AND 70th STREET WEST. 2–INCH O.D. IRON PIPE FILLED WITH CONCRETE WITH CHISELED MARK ON HIGH POINT. ELEVATION: 2390.57 FEET <RECORD>, 2390.33 FEET OBSERVED) PROJECT POINT NO. 513.
TOLERANCE ± 0.25–FEET

## TEMPORARY BENCH MARK (TBM):

NORTHEAST CORNER OF CONCRETE PAD OF SAMPLING STATION APPROXIMATELY 25–FEET NORTH OF THE TREATED WATER RESERVOIR, (ELEVATION OF ORIGINAL WTP SURVEY=2384.00–FEET) ELEVATION FOR THE SNIPS PUMP STATION=2386.78–FEET.

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| REV | DATE | DESCRIPTION | APPR |
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DESIGNED BY: BPH
DRAWN BY: VENE
CHECKED BY:
DATE: DEC. 2010

PROJECT ENGINEER: BEN P. HORN
REG NUMBER: C 23028 EXP DATE: 12/31/11
PROJECT NUMBER: 60182837
CADD STANDARDS

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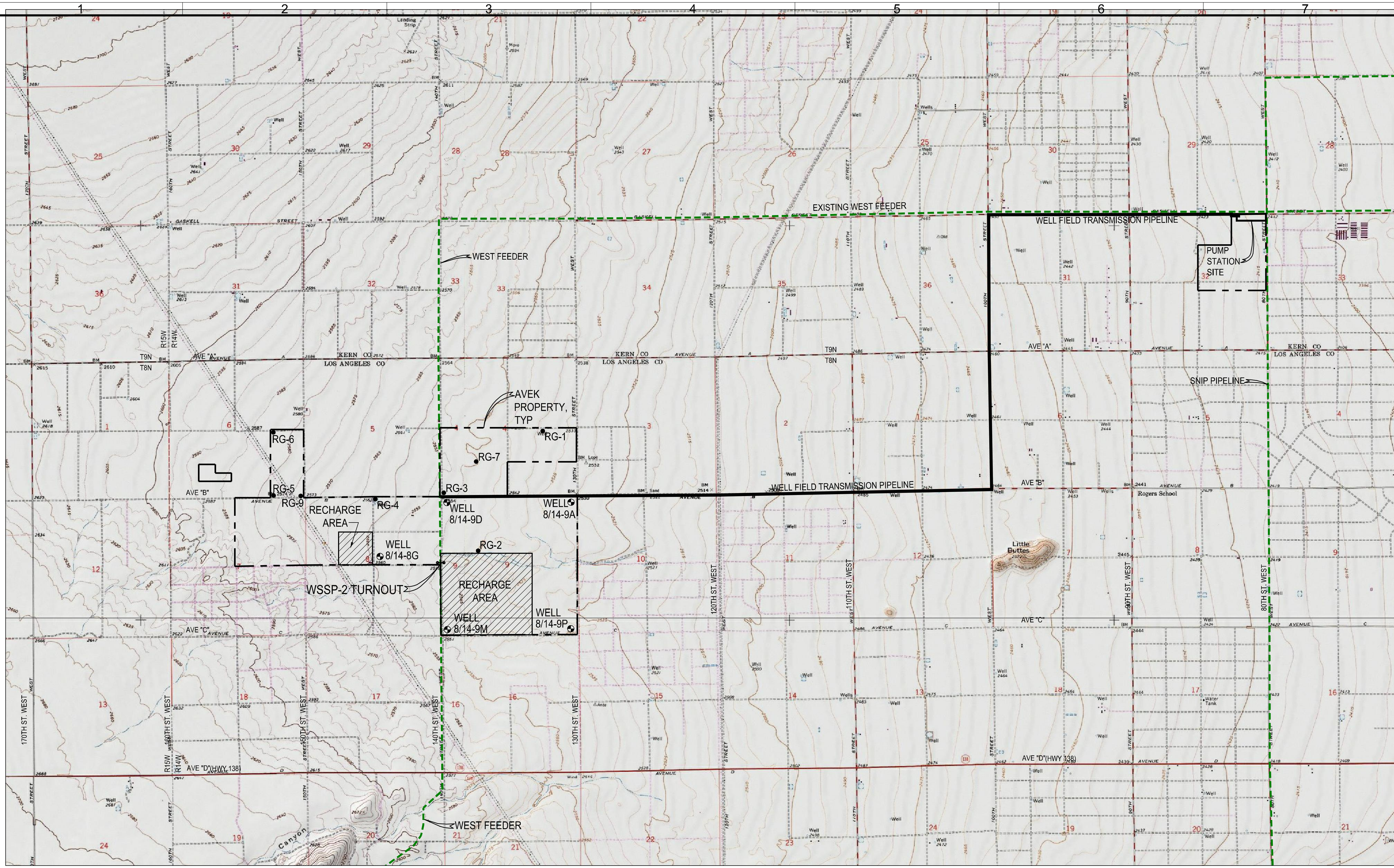
WATER SUPPLY STABILIZATION PROGRAM - 2

SHEET INDEX AND CONSTRUCTION NOTES

DRAWING: G-02
SHEET: 2
OF – SHEETS
S–2468




VICINITY MAP

0 2000 4000
SCALE IN FEET

LEGEND

- EXISTING WELLS
- PROPOSED WELLS

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DATE: DEC. 2010

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WATER SUPPLY STABILIZATION PROGRAM - 2

PROJECT MAP

DRAWING: G-03
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OF – SHEETS
S-2468

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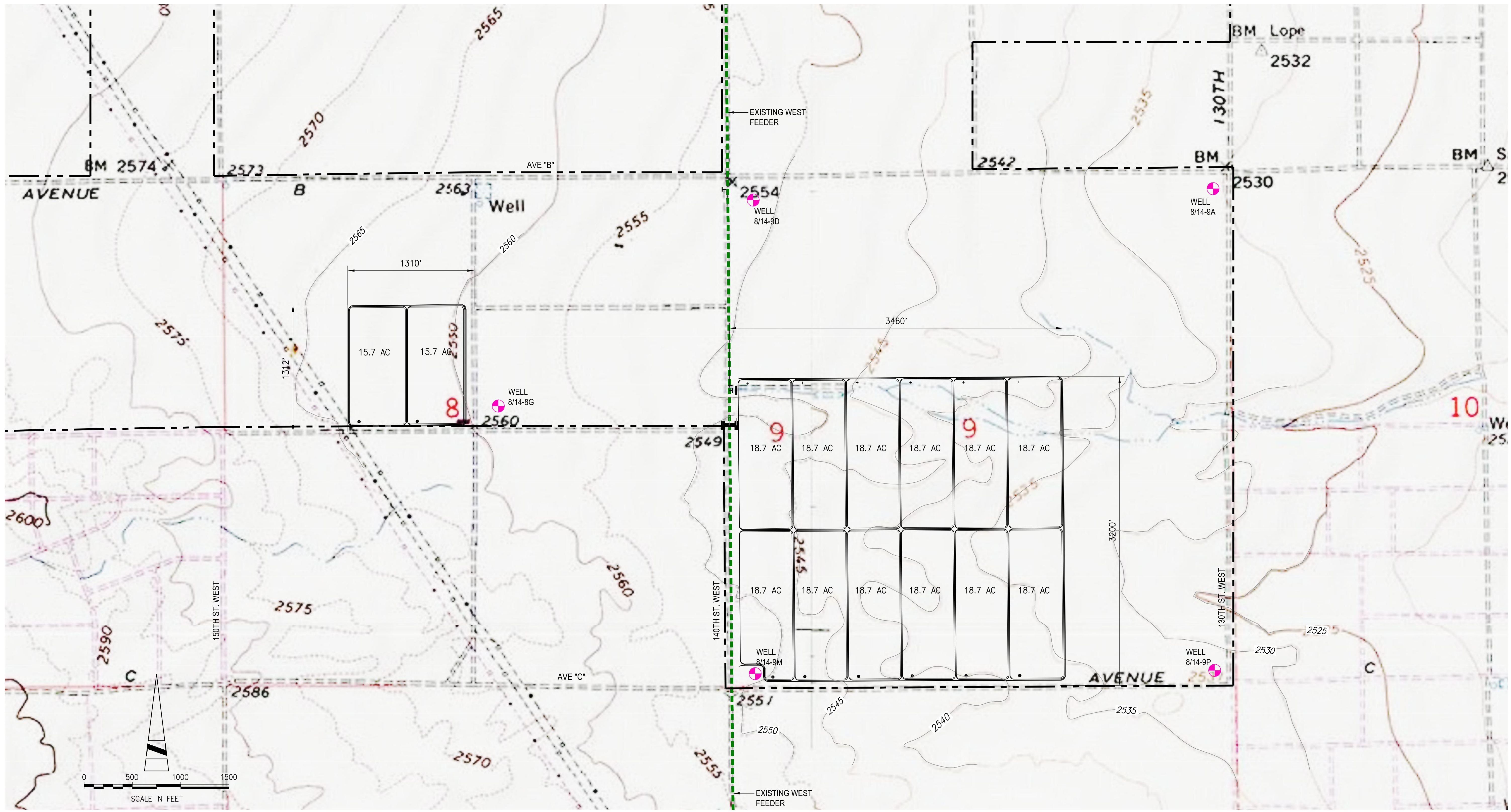


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WATER SUPPLY STABILIZATION PROGRAM - 2

RECHARGE BASIN PLAN

DRAWING: C-01
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OF – SHEETS
S-2468

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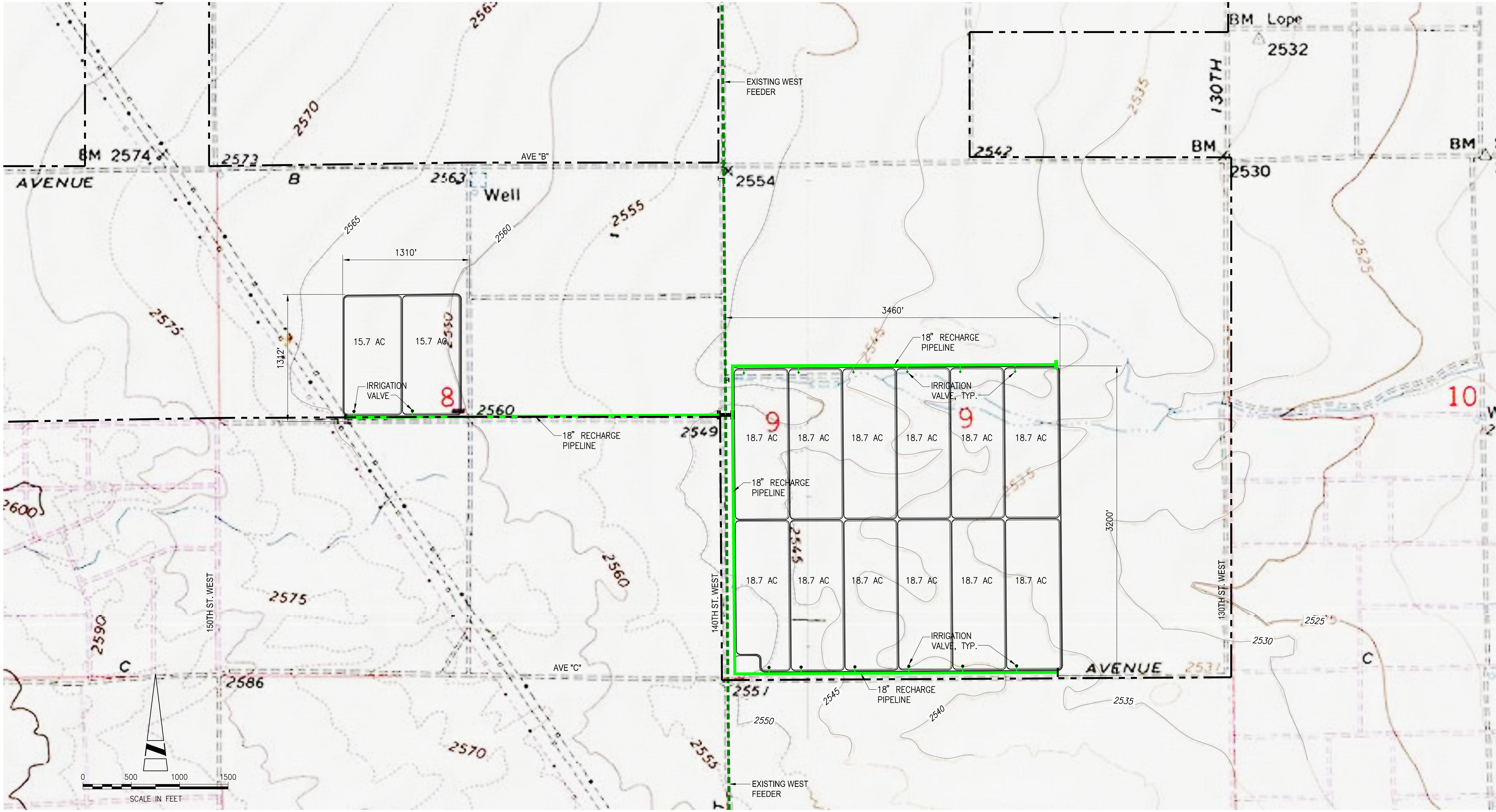


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WATER SUPPLY STABILIZATION PROGRAM - 2

RECHARGE PIPELINES

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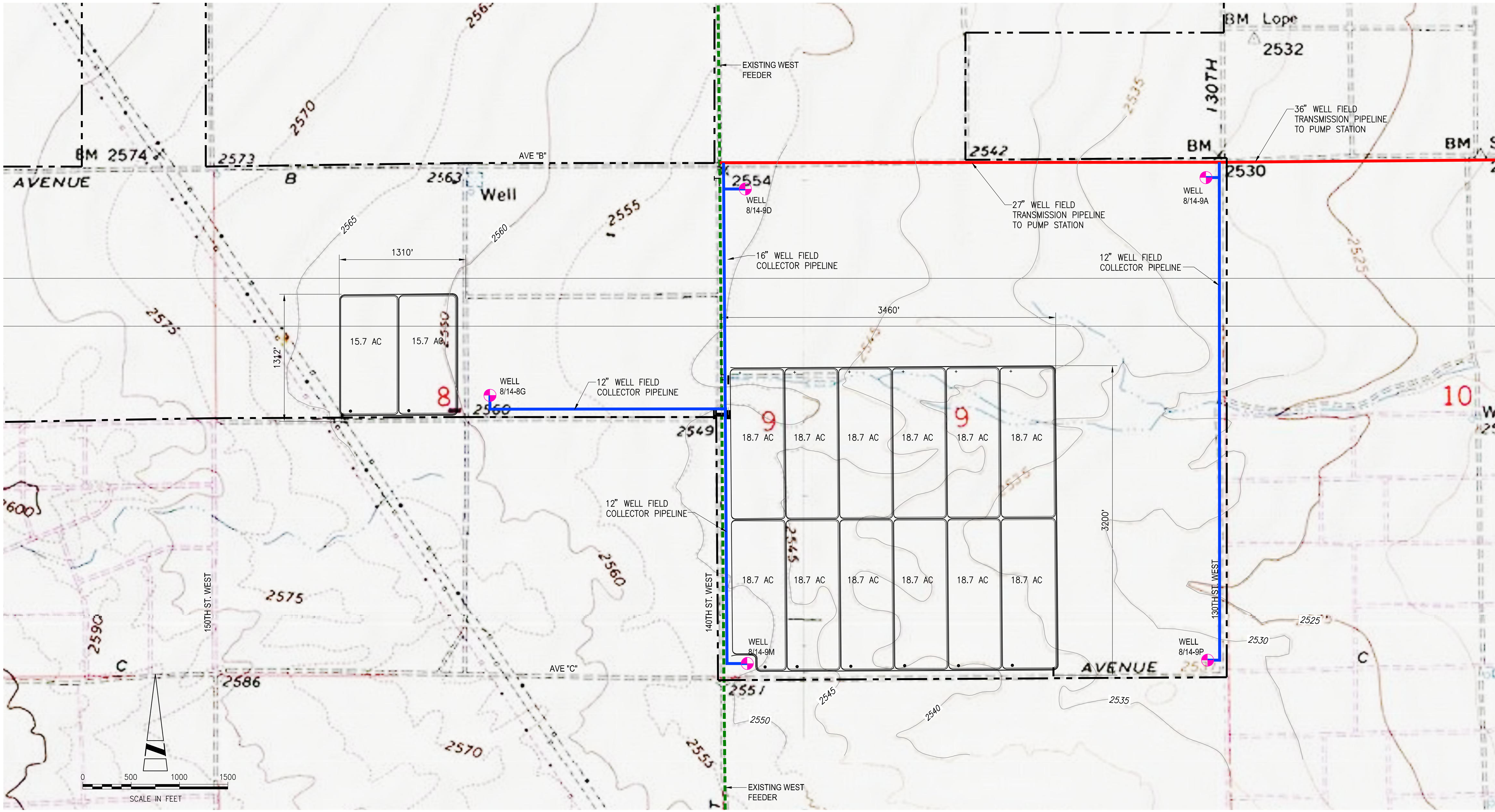


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# WATER SUPPLY STABILIZATION PROGRAM - 2

## WELL FIELD COLLECTOR PIPELINES

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S-2468

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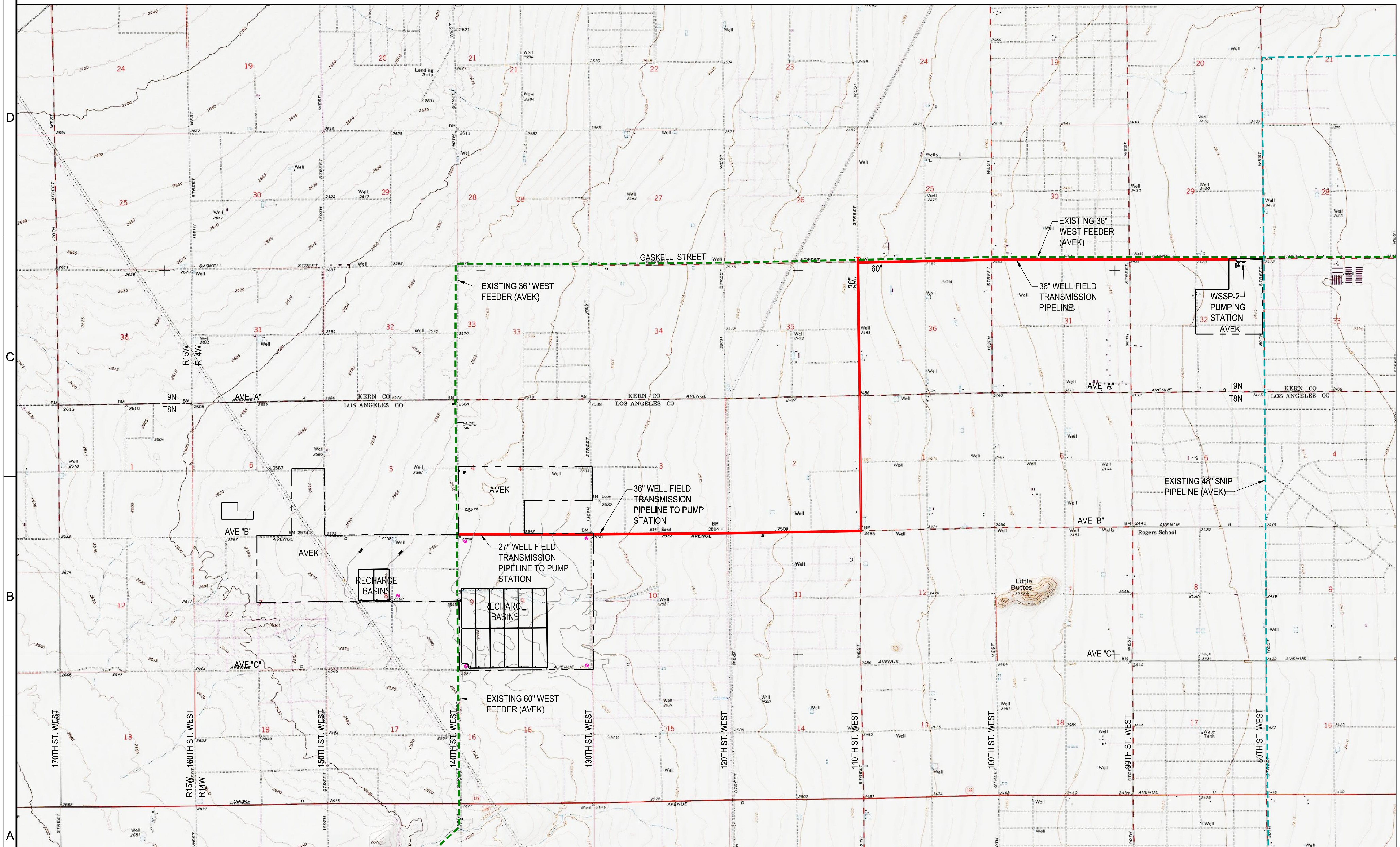


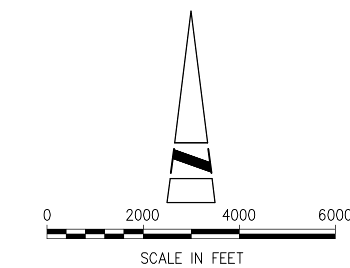


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# WATER SUPPLY STABILIZATION PROGRAM - 2

# WELL FIELD TRANSMISSION PIPELINES

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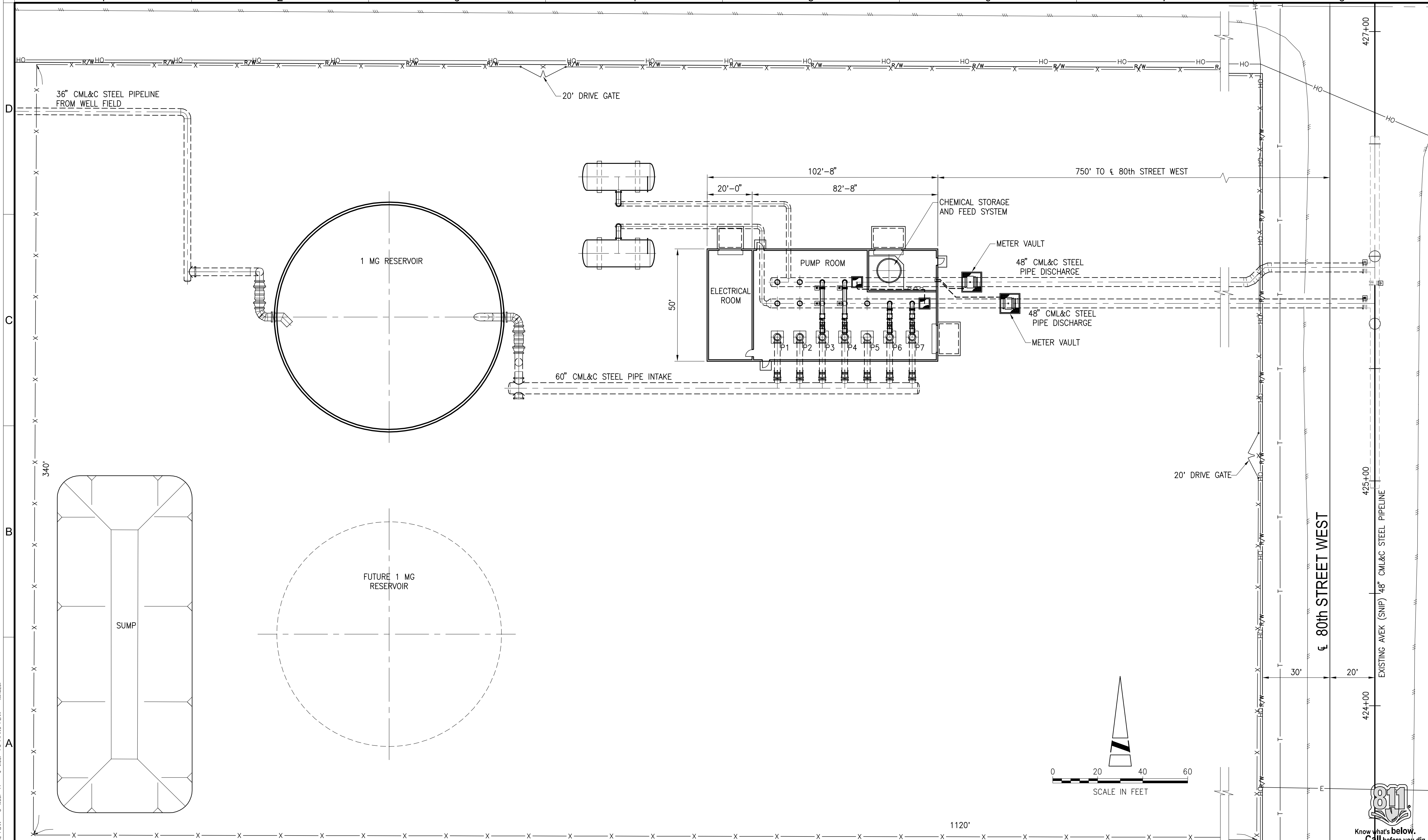
S-2468

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WATER SUPPLY STABILIZATION PROGRAM - 2

PUMP STATION SITE PLAN

DRAWING: C-05
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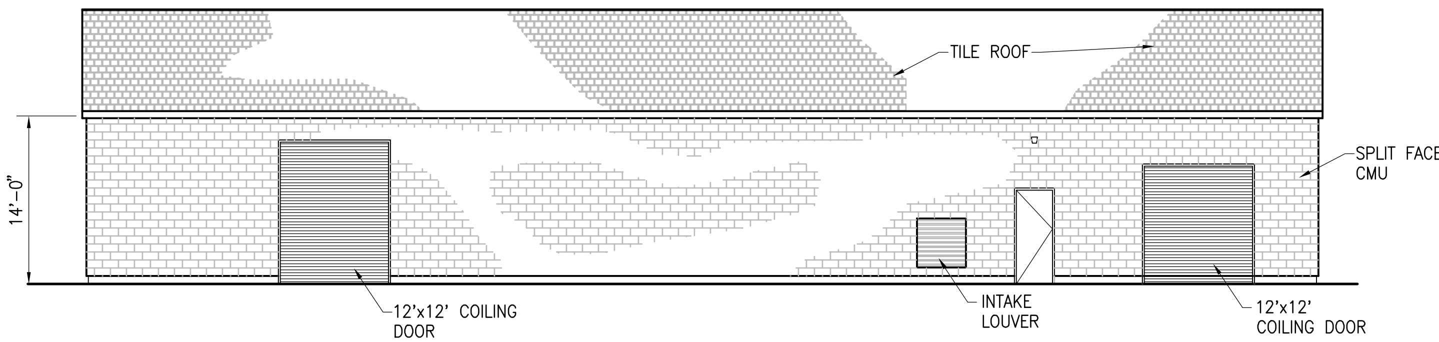
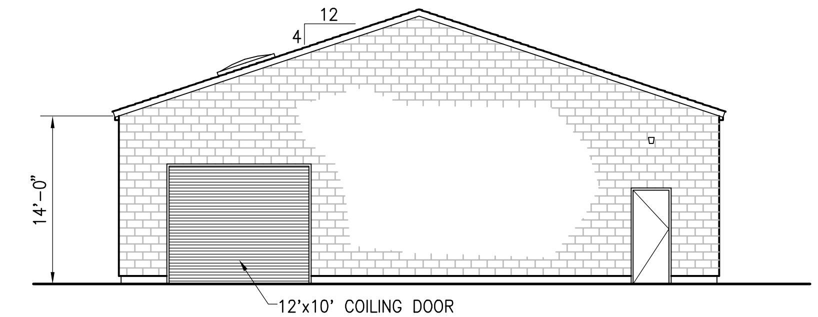
OF – SHEETS
S-2468




NORTH ELEVATION (A / -)

SCALE: 1/4"=1'-0"




EAST ELEVATION (D / -)

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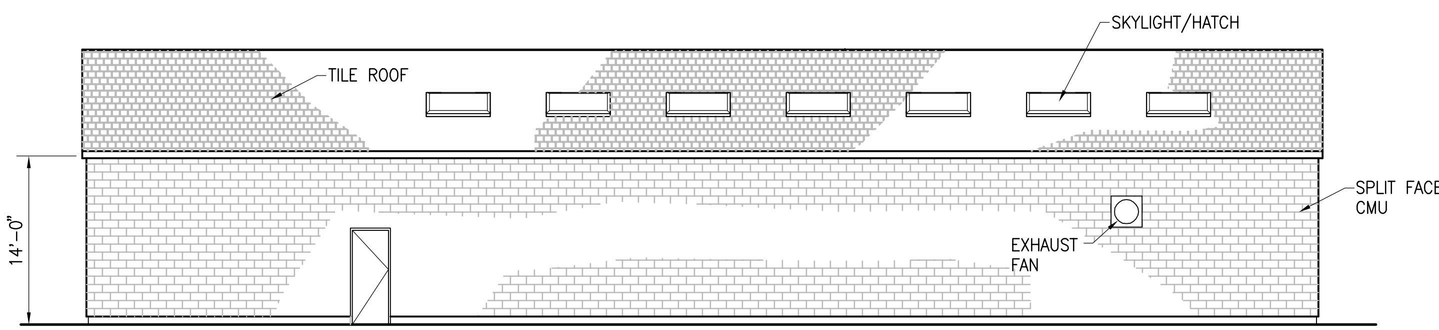


SOUTH ELEVATION (B / -)

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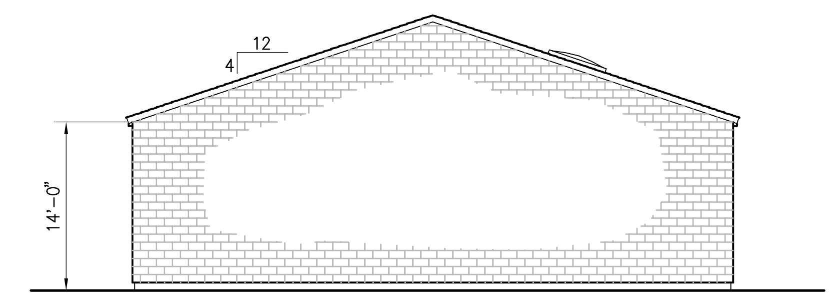


WEST ELEVATION (C / -)

SCALE: 1/4"=1'-0"

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| PROJECT ENGINEER | MARVIN DAN SCHMIDT |
| REG NUMBER | C15641 |
| EXP DATE | 3/31/11 |
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WATER SUPPLY STABILIZATION PROGRAM - 2

PUMP STATION EXTERIOR ELEVATIONS

| | |
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| DRAWING | C-06 |
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| | S-2468 |

# Attachment 3 Exhibit
# IRWM Plan Regional Map

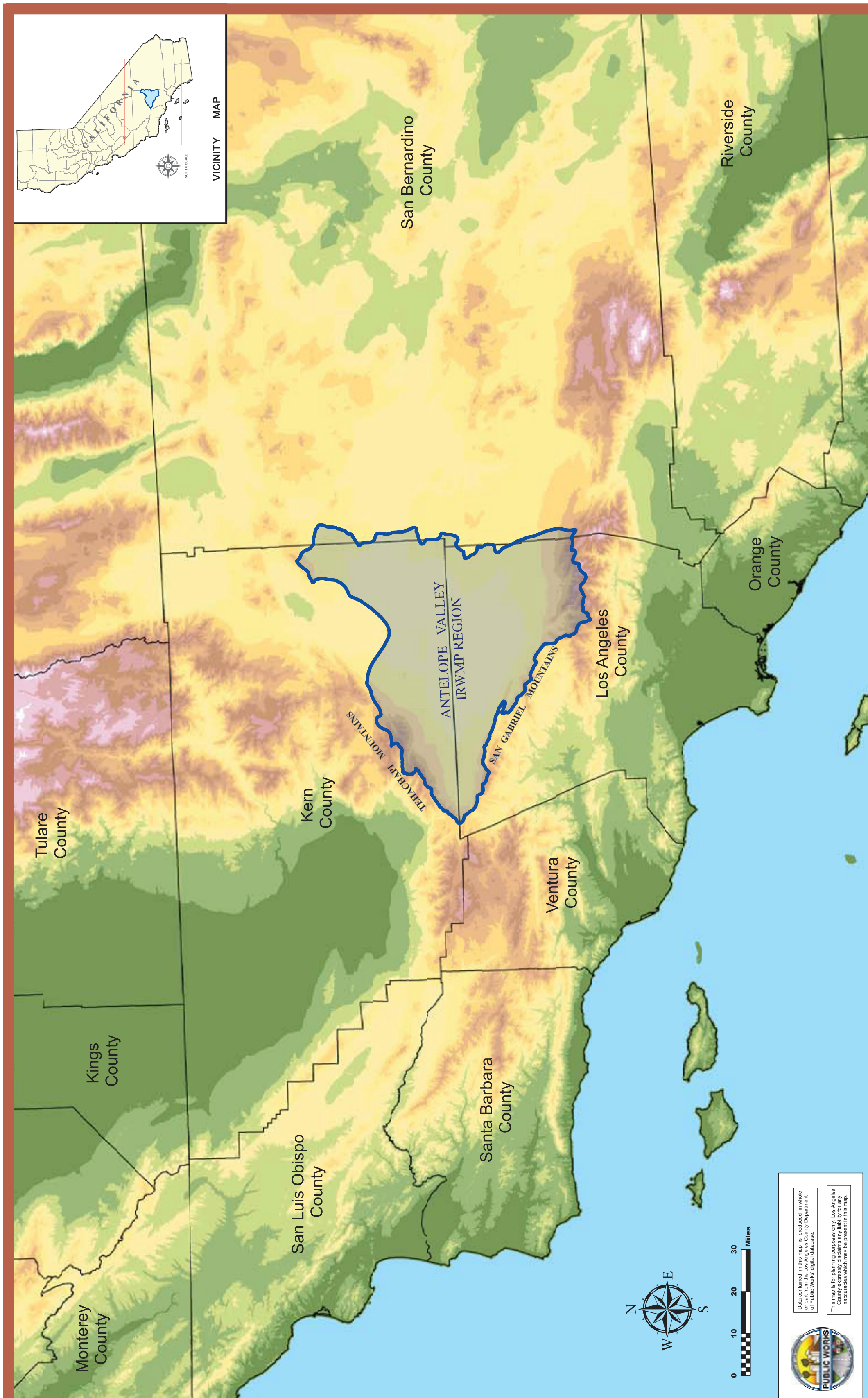



Figure 1-1 Antelope Valley Integrated Regional Water Management Plan Region

# Attachment 3 Exhibit
# Applicant Resolution Adopting Project Mitigated Negative Declaration

**ANTELOPE VALLEY-EAST KERN WATER AGENCY**

**RESOLUTION NO.: R-08-20**

**RESOLUTION APPROVING MITIGATED NEGATIVE DECLARATION**

**A RESOLUTION OF THE BOARD OF DIRECTORS OF THE ANTELOPE VALLEY EAST KERN WATER AGENCY APPROVING THE MITIGATED NEGATIVE DECLARATION FOR THE AVEK WATER SUPPLY STABILIZATION PROGRAM GROUNDWATER RECHARGE PROJECT (WSSP-2), AND ADOPTING A MITIGATION MONITORING AND REPORTING PLAN**

**WHEREAS,** it is the goal of the Board of Directors of the Antelope Valley-East Kern Water Agency (the "Agency") to stabilize water supplies for its customers during periods of drought or loss of supply due to damage or failure of State Water Project facilities by recharging the Antelope Valley Groundwater Basin using the portion of the Agency's annual allotment of State Water Project imported water and other water that may become available to AVEK that exceeds annual demand and subsequently recovering this stored water (less losses) to meet dry-year and emergency demand); and

**WHEREAS,** to facilitate this goal, the Agency has developed a Water Supply Stabilization Program Groundwater Recharge Project ("WSSP-2") plan to (a) recharge water on lands it owns in Los Angeles County south of West Avenue A, north of West Avenue C (b), east of 155th Street West and west of 130the Street West; (b) recover recharged supplies when needed, and (c) convey these supplies in a system of pipelines to either the AVEK West Feeder or (via a new pipeline) to a storage, treatment, and pumping plans and (following treatment) to the AVEK SNIP treated water pipeline; and

**WHEREAS,** the Board of Directors of the Agency has determined that the WSSP-2 is considered a project pursuant to the requirements of the California Environmental Quality Act, Public Resources Code Section 21000 et. seq. ("CEQA"), and prepared an initial study to determine potential environmental impacts; and

**WHEREAS,** on the basis of the initial study, which indicated that all potential environmental impacts from the WSSP-2 were less than significant, or could be mitigated to a level of insignificance, the Agency's staff, determined that a Mitigated Negative Declaration ("MND") should be prepared; and

**WHEREAS,** the MND was prepared pursuant to CEQA, and the California State CEQA Guidelines; and

**WHEREAS,** the MND was made available to the public and all interested agencies for review and comment by publishing notice of its availability in the *Antelope Valley Press* a newspaper of general circulation on July 1, 2, and 3, 2008, and by submission to the State Clearinghouse for review on or about July 2, 2008, and circulated for a period of 30 days pursuant to State CEQA Guidelines; and

**WHEREAS,** a public meeting of the Board of Directors of the Agency to consider the MND, initial study, and potential mitigation monitoring and reporting plan for the WSSP-2 was held on November 10, 2008; and

**WHEREAS,** the Board of Directors of the Agency received, considered, and responded to comments, including oral comments received from the public and other interested entities on the MND; and

**WHEREAS,** the Board of Directors of the Agency have carefully reviewed the MND and all other relevant information contained in the record regarding the WSSP-2; and

**WHEREAS,** all other legal prerequisites to the adoption of this Resolution have occurred.

**NOW, THEREFORE, BE IT RESOLVED** BY THE BOARD OF DIRECTORS OF THE ANTELOPE VALLEY-EAST KERN WATER AGENCY AS FOLLOWS:

**1. <u>Compliance with the California Environmental Quality Act.</u>**

The Board of Directors of the Agency have reviewed and considered the information contained in the MND, the initial study, and the administrative record for the WSSP-2, including all oral and written comments received during the comment period. The Board of Directors find that the MND and the initial study contain a complete and accurate reporting of the environmental impacts associated with the WSSP-2. The Board of Directors find that MND, initial study, and administrative record have been completed in compliance with CEQA and the California State CEQA Guidelines. The Board of Directors further find that all potential impacts in the WSSP-2 have been fully analyzed in the MND.

**2. <u>Findings on Environmental Impacts.</u>**

Based on the MND, the initial study, and the administrative record including all written and oral evidence presented to the Board of Directors, the Board of Directors find that all environmental impacts of the WSSP-2 are either insignificant or can be mitigated to a level of insignificance pursuant to the mitigation measures outlined in the MND and the initial study. The Board of Directors further find that there is no substantial evidence in the administrative record supporting a fair argument that the WSSP-2 may result in significant environmental impacts. The Board of Directors find that the MND contains a complete, objective, and accurate reporting of the environmental impacts associated with the WSSP-2 and reflects the independent judgment of the Agency.

**3. <u>Adoption of Mitigated Negative Declaration.</u>**

The Board of Directors hereby approve and adopt the Mitigated Negative Declaration.

4. **<u>Adoption of Mitigation Monitoring and Reporting Program</u>.**

The Board of Directors hereby approve and adopt the Mitigation Monitoring and Reporting Program prepared for the WSSP-2.

5. **<u>Approval of WSSP-2.</u>**

The Board of Directors hereby approve the Water Supply Stabilization Program and Groundwater Recharge Project (WSSP-2).

6. **<u>Notice of Determination</u>.**

The Board of Directors direct staff to fill a Notice of Determination with the **Los Angeles County Clerk** within five (5) working days of WSSP-2 approval by the Board of Directors of the Agency.

7. **<u>Custodian of Records.</u>**

The documents and materials that constitute the record of proceedings on which these findings have been based are located at the Antelope Valley-East Kern Water Agency, 6500 West Avenue N., Palmdale, California 93551. The custodian for these records in the General Manager of the Antelope Valley-East Kern Water Agency.

8. **<u>Execution of Resolution.</u>**

The President of the Board of Directors shall sign this resolution and the Secretary of the Board of Directors shall attest and certify to the passage and adoption thereof.

9. **<u>Effective Date.</u>**

This Resolution shall be deemed effective upon adoption.

**PASSED, APPROVED, AND ADOPTED THIS 10th DAY OF NOVEMBER 2008**

**AYES:**
**NOES:**
**ABSTAIN:**
**ABSENT:**

**SIGNED:**

President, AVEK Water Agency

**ATTEST:**

Secretary, AVEK Water Agency

**APPROVED AS TO FORM:**

William J. Brunick, AVEK General Counsel

# Attachment 3 Exhibit
# WSSP No. 2 Turnout Project Construction Plans

"CONFORMED DRAWINGS"

12-27-10

## CONSTRUCTION PLANS FOR:

# ANTELOPE VALLEY-EAST KERN WATER AGENCY

## WSSP-2 TURNOUT

## NOVEMBER 2010

APPROVED, AVEK
BOARD OF DIRECTORS

GEORGE M. LANE, PRESIDENT

KEITH DYAS, VICE PRESIDENT

CARL B. HUNTER, JR.

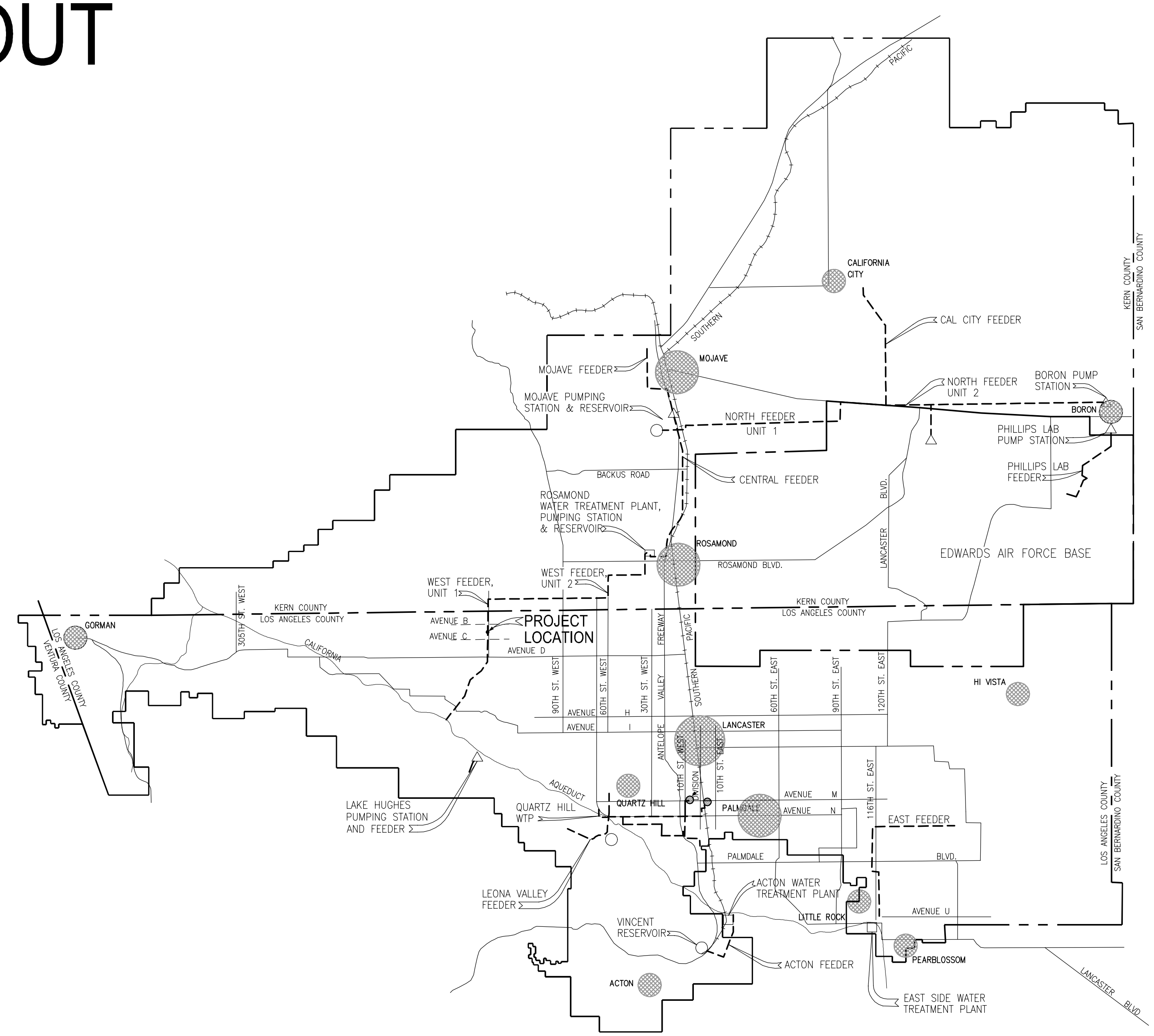
DAVID RIZZO

FRANK S. DONATO

ANDY D. RUTLEDGE

MARLON BARNES

DAN FLORY, GENERAL MANAGER




CLIENT

ANTELOPE VALLEY - EAST KERN WATER AGENCY
AVEK
ESTABLISHED 1959
A PUBLIC AGENCY

PROJECT

WSSP-2 TURNOUT

PROJECT MANAGER — REGISTERED PROFESSIONAL ENGINEER BEN P. HORN No. 23028 EXP. 12-31-11 CIVIL STATE OF CALIFORNIA — 11-18-10 DATE

PROJECT ENGINEER — REGISTERED PROFESSIONAL ENGINEER ERIC H. GARIBAY No. RCE 72121 EXP. 6-30-12 CIVIL STATE OF CALIFORNIA — 11-18-10 DATE

1

| ACCOUNT NUMBER | FILE NUMBER |
|---|---|
| 60182837 | S-2465 |

| SHEET NUMBER | OF | SHEETS |
|---|---|---|
| 1 | | 6 |

AECOM

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Bakersfield, California 93309
T 661.325.7253 F 661.395.0359

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1 12-03-10 REVISED PER ADDENDUM NO. 1 – BPH

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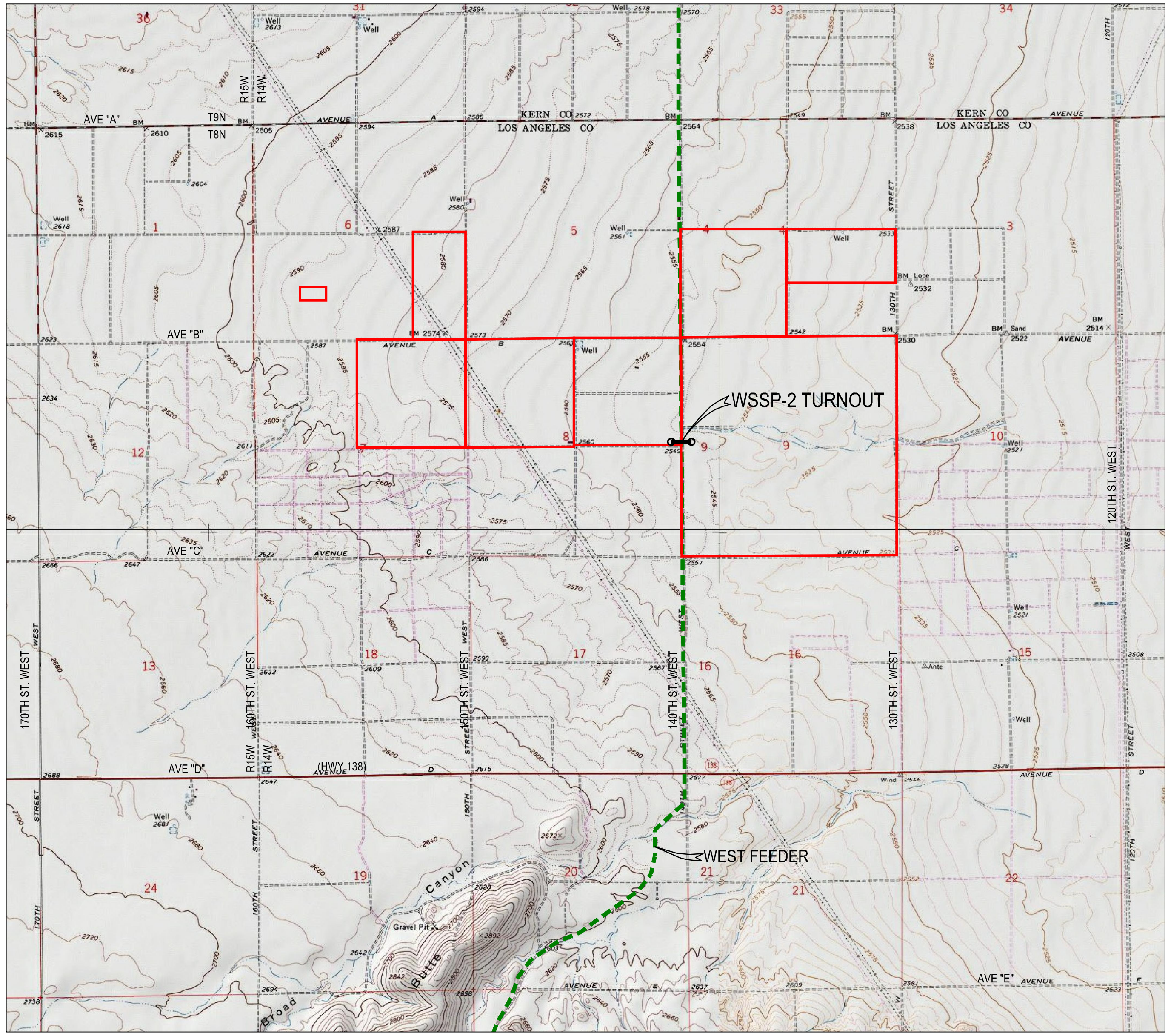


## VICINITY MAP

0 2000 4000
SCALE IN FEET

## GENERAL NOTES

1. ALL ELEVATIONS ARE TO THE TOP OF PIPE BARREL UNLESS OTHERWISE INDICATED.
2. ALL NATURAL AND EXISTING GROUND OR PAVEMENT ELEVATIONS ARE APPROXIMATE ONLY.
3. MINIMUM COVER OVER TOP OF PIPE SHALL BE 4.5–FEET.
4. THE INDICATED LOCATIONS OF EXISTING UNDERGROUND FACILITIES ARE FROM THE BEST AVAILABLE SOURCES, BUT MAY NOT NECESSARILY EXIST AS SHOWN ON THESE DRAWINGS. THE CONTRACTOR SHALL EXPOSE ALL POTENTIAL INTERFERENCE'S AHEAD OF TRENCHING OPERATION AND SHALL IMMEDIATELY INFORM THE AGENCY'S REPRESENTATIVE IF THERE IS A CONFLICT. VERIFY LOCATION PRIOR TO PIPELINE INSTALLATION. REFER TO SPECIFICATION SECTION 020120.
5. COMPLY WITH REQUIREMENTS OF THE ENCROACHMENT PERMIT ISSUED BY THE COUNTY OF LOS ANGELES.
6. CONTACT UTILITY COMPANIES WITH SERVICES IN THE AREA FOR LOCATING UNDERGROUND LINES AND CABLES, AND SHALL COORDINATE WITH THE UTILITY FACILITIES AFFECTED BY THE PIPELINE CONSTRUCTION. PRIOR TO ANY EXCAVATION NEAR EXISTING FACILITIES, CONTACT UNDERGROUND SERVICE ALERT.
7. SURVEY MONUMENTS DISTURBED DURING CONSTRUCTION ARE TO BE REPLACED TO THEIR ORIGINAL LOCATION.
8. SIGNS AND POSTS REMOVED DURING CONSTRUCTION SHALL REPLACE TO THEIR ORIGINAL LOCATION.
9. PROVIDE FIVE (5) WORKING DAYS NOTICE PRIOR TO THE NEED FOR CONSTRUCTION STAKING.
10. VERIFY THE SIZE, TYPE, CLASS, PROTECTIVE LINING AND COATING, LOCATION AND DEPTH OF THE EXISTING WATER MAIN AND SHALL BE RESPONSIBLE FOR MAKING THE PROPER CONNECTIONS.
11. WORK SHALL BE CONFINED WITHIN LA CO. RIGHT–OF–WAY (ENCROACHMENT PERMIT) AND AVEK PROPERTY.
12. (1) BOTH 60–INCH AND 30–INCH PIPELINES SHALL BE SWEPT CLEAN FROM ALL DEBRIS PRIOR TO PLACING THE PIPELINE IN OPERATION.
13. (1) SHOP HYDROTEST ALL PIPELINE, FITTINGS, AND SPECIALS IN ACCORDANCE WITH SECTION 402001.

## SHEET INDEX



## AGENCIES EXERCISING RESPONSIBILITY FOR SERVICES.

WATER
ANTELOPE VALLEY–EAST KERN WATER AGENCY...........1–661–943–3201

TELEPHONE
AT&T...........................................................................1–818–373–5068

ELECTRIC
SOUTHERN CALIFORNIA EDISON....................................1–800–635–4555

USA
UNDERGROUND SERVICE ALERT....................................1–800–422–4133

Know what's **below.**
**Call** before you dig.

| REV | DATE | DESCRIPTION | APPR |
|---|---|---|---|
| 7 | | | |
| 6 | | | |
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | | | |
| 1 | 12–03–10 | REVISED PER ADDENDUM NO. 1 | BPH |

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DRAWN BY VENE
CHECKED BY AR
DATE NOV. 2010

PROJECT ENGINEER BEN P. HORN
REG NUMBER C 23028 EXP DATE 12/31/11
PROJECT NUMBER 60182837
CADD STANDARDS AECOM

REGISTERED PROFESSIONAL ENGINEER
ERIC H. GARIBAY
No. RCE 72121
EXP. 6–30–12
CIVIL
STATE OF CALIFORNIA
1

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WSSP-2 TURNOUT

VICINITY MAP, SHEET INDEX AND CONSTRUCTION NOTES

DRAWING G-02
SHEET 2 OF 6 SHEETS
S–2465

DWG: S:\A01\60182837\WSSP-2\CAD\Planset\G-02.dwg Layout Name: G-02 – Plotted by: Campbell, Vene Date: 12/27/2010 – 1:03 PM
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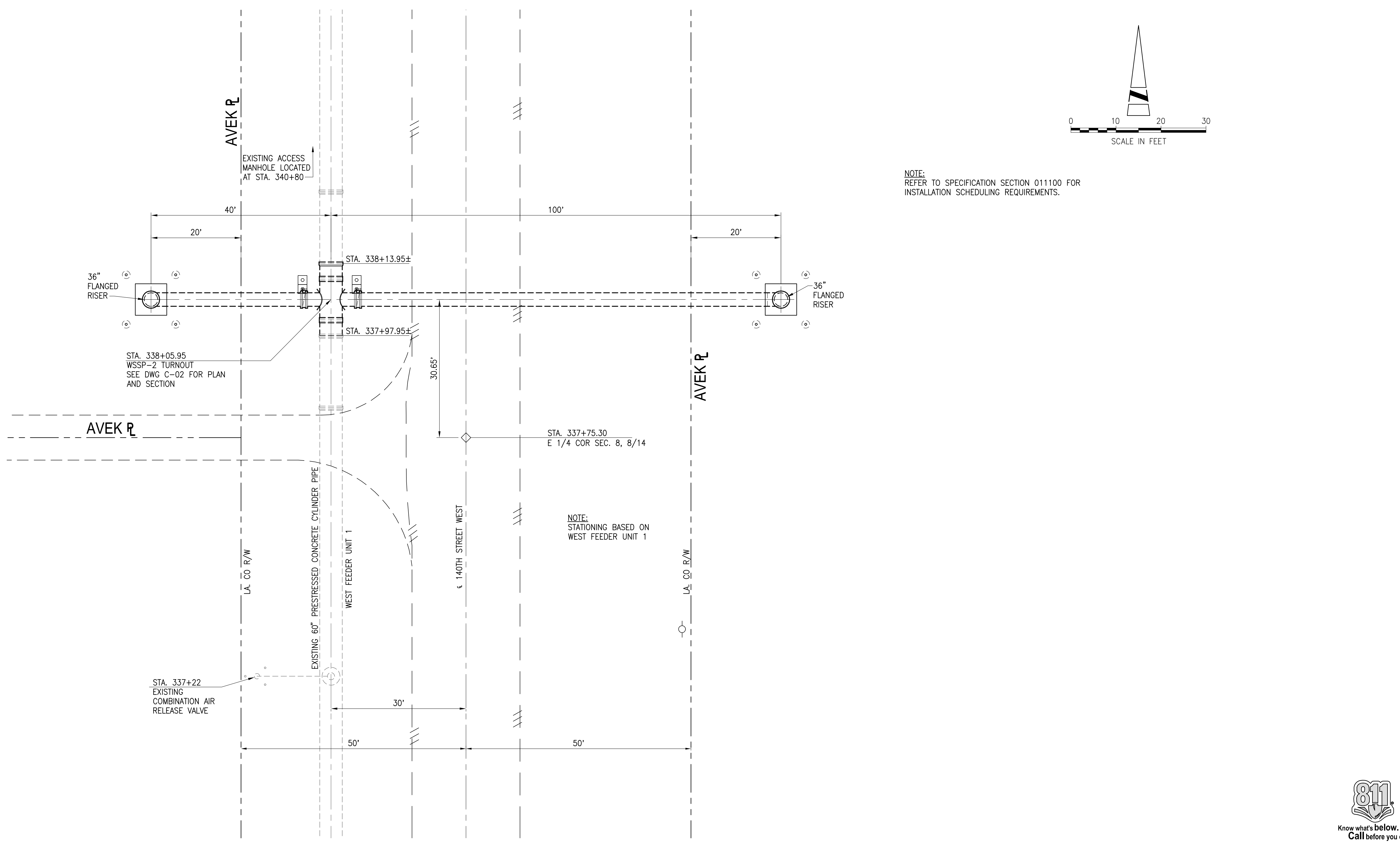


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DATE: NOV. 2010

PROJECT ENGINEER: BEN P. HORN
REG NUMBER: C 23028 — EXP DATE: 12/31/11
PROJECT NUMBER: 60182837
CADD STANDARDS: AECOM

REGISTERED PROFESSIONAL ENGINEER — ERIC H. GARIBAY — No. RCE 72121 — EXP. 6-30-12 — CIVIL — STATE OF CALIFORNIA


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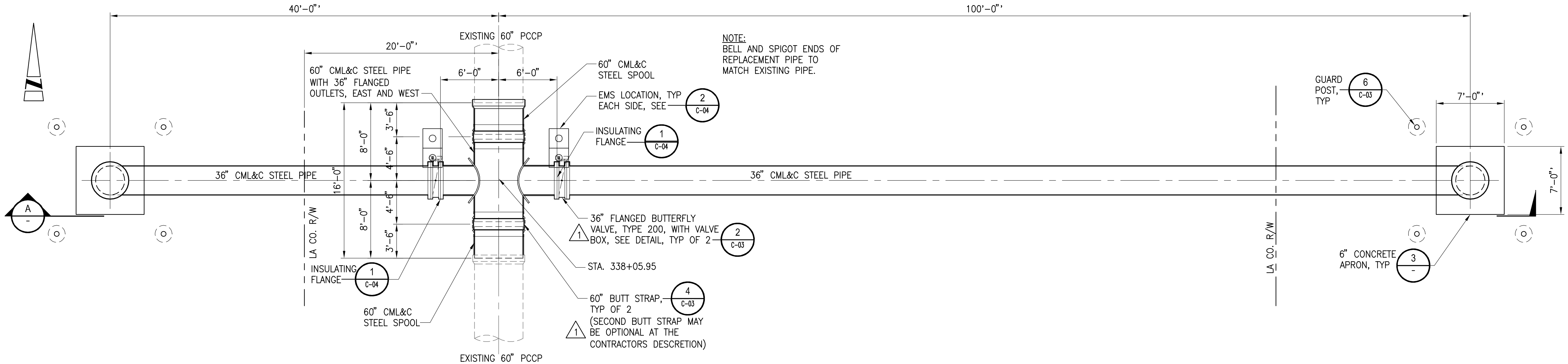
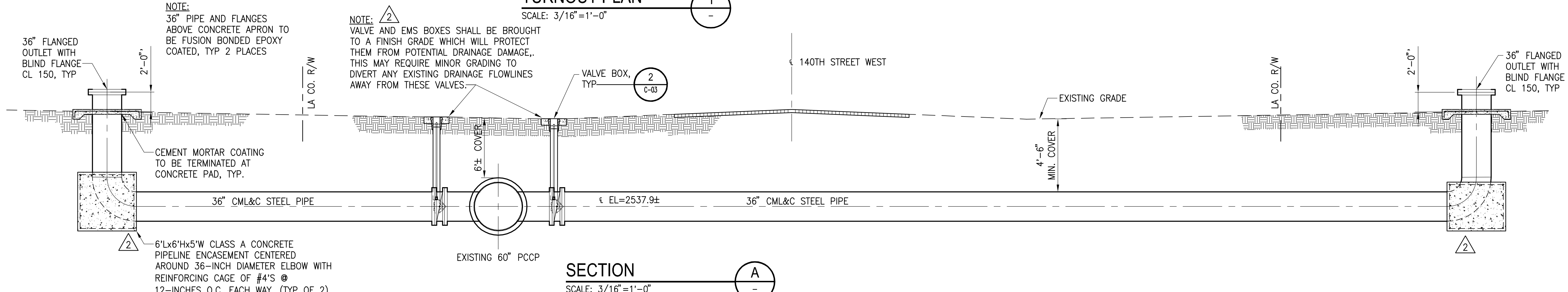
WSSP-2 TURNOUT

TURNOUT SITE PLAN

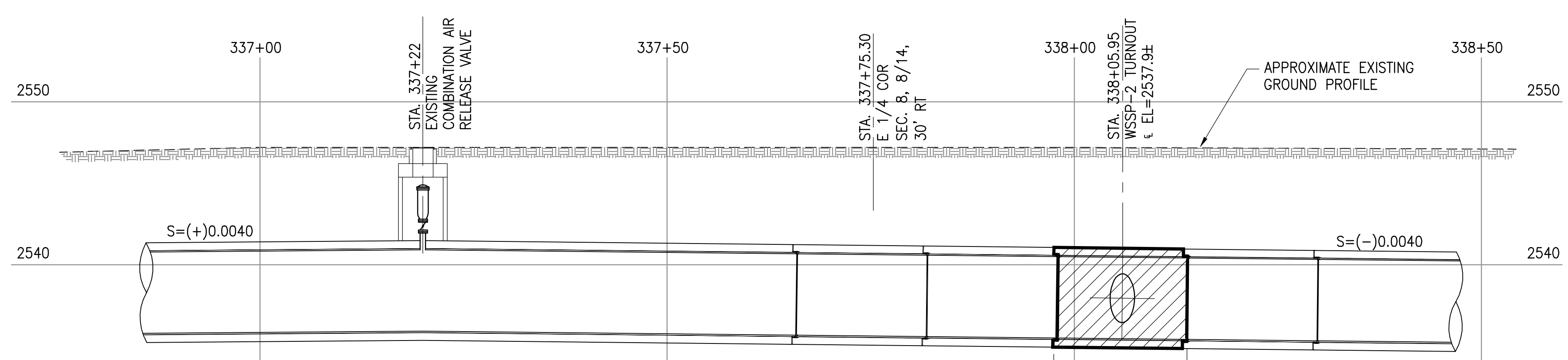
DRAWING: C-01
SHEET 3 OF 6 SHEETS
S-2465



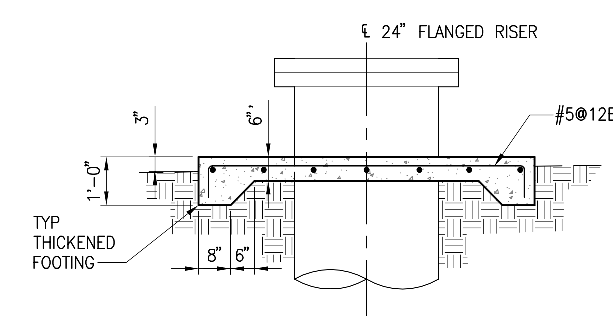

TURNOUT PLAN 1
SCALE: 3/16"=1'-0"




SECTION A
SCALE: 3/16"=1'-0"




EXISTING WEST FEEDER UNIT 1 PROFILE 2
SCALE: HORIZ 1"=10'
VERT. 1"=5'




CONCRETE APRON 3
SCALE: 1/2"=1'-0"

Know what's **below.** **Call** before you dig.

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|---|---|---|---|
| 2 | 12-09-10 | REVISED PER ADDENDUM NO. 2 | BPH |
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DATE: NOV. 2010

PROJECT ENGINEER: BEN P. HORN
REG NUMBER: C 23028 EXP DATE: 12/31/11
PROJECT NUMBER: 60182837
CADD STANDARDS: AECOM

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WSSP-2 TURNOUT

TURNOUT PLAN AND SECTION

DRAWING C-02
SHEET 4 OF 6 SHEETS
S-2465

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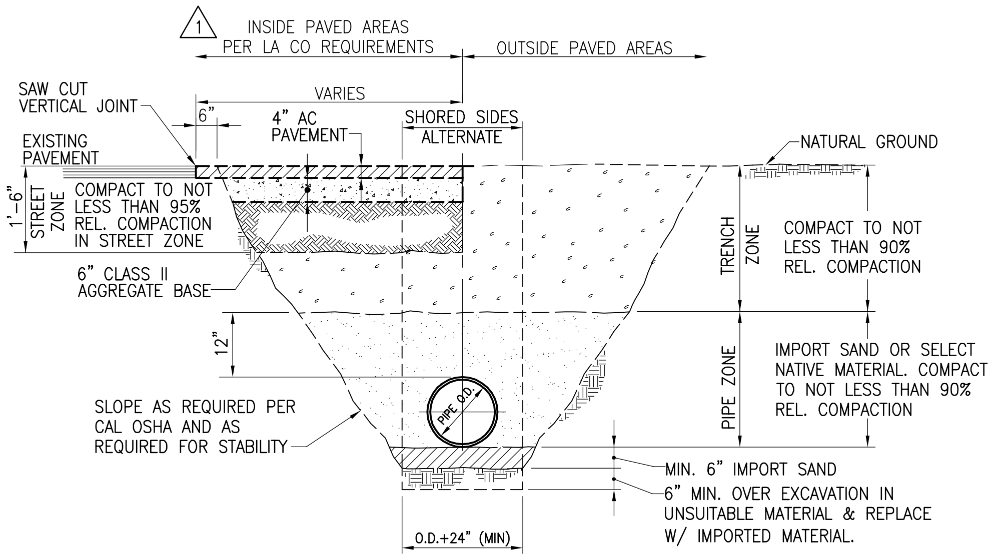
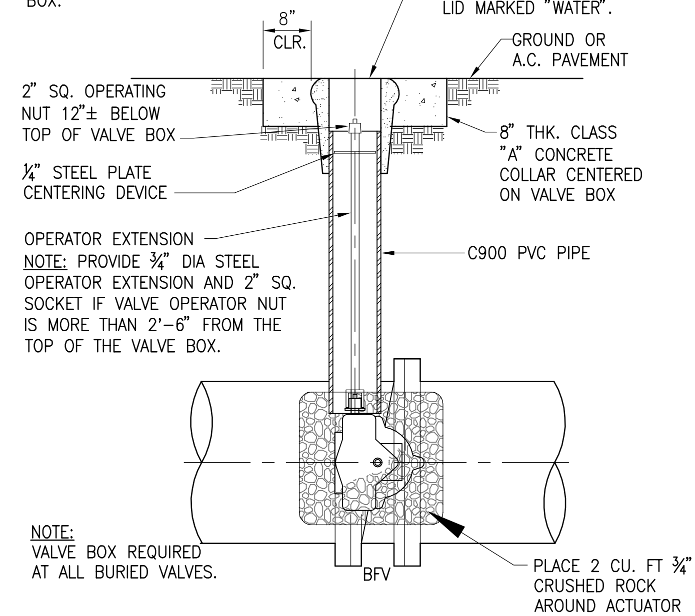



## TYP. TRENCH DETAIL (1/–)

NOT TO SCALE

NOTE:
CONCRETE COLLAR SHALL BE POURED SQUARE AT A MINIMUM OF 8-INCHES CLEAR FROM THE O.D. OF THE VALVE BOX.

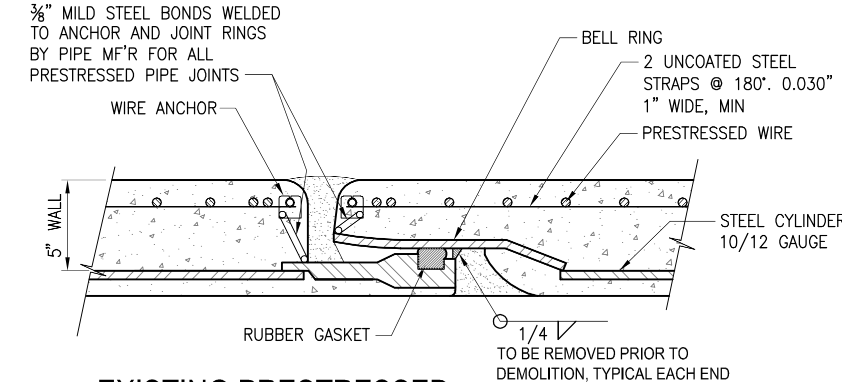



NOTE:
VALVE BOX REQUIRED AT ALL BURIED VALVES.

## TYPICAL VALVE BOX (2/–)

NOT TO SCALE

NOTE:
⅜" MILD STEEL BONDS WELDED TO ANCHOR AND JOINT RINGS BY PIPE MF'R FOR ALL PRESTRESSED PIPE JOINTS




## EXISTING PRESTRESSED CONCRETE CYLINDER PIPE JIONT (3/–)

NOT TO SCALE

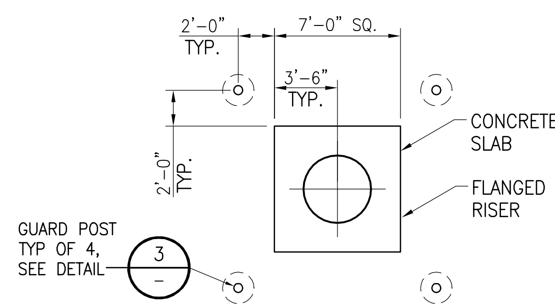
1 SEE ADDENDUM NO. 1, DRAWING C-03, TURNOUT PIPING DETAIL

NOTES:

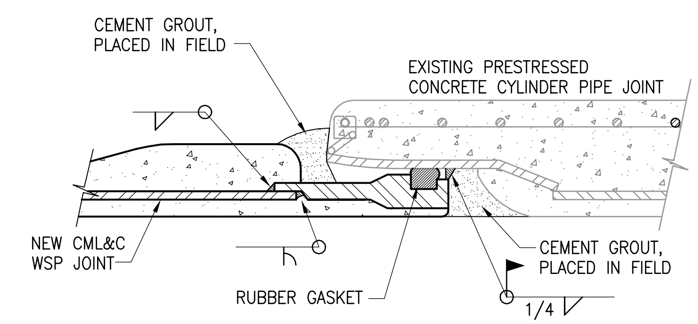
1. REPLACE 16-FOOT JOINT OF PRESTRESSED CONCRETE CYLINDER PIPE WITH CEMENT MORTAR LINED AND COATED WELDED STEEL PIPE (PER SPECIFICATION SECTION 402063).
2. PRIOR TO FABRICATING REPLACEMENT PIPE SECTION VERIFY JOINT DETAIL AND LENGTH TO DETERMINE CML&C WSP JOINT REQUIREMENTS.
3. REMOVE 16-FOOT SECTION OF PRESTRESSED CONCRETE CYLINDER PIPE PER DWG. C-01.
   NOTE-1/4-INCH FIELD WELD AT JOINT THAT WILL NEED TO BE REMOVED PRIOR TO SECTION DEMOLITION.
4. EXISTING PIPE JOINTS ON EACH END OF JOINT BEING REMOVED SHALL NOT BE DISTURBED.

NOTES:

1. PRIOR TO SUBMITTAL OF SHOP DRAWINGS CONTRACTOR SHALL VERIFY ELEVATION AND LOCATION OF EXISTING PIPE JOINT AND JOINT DETAILS TO PROVIDE PROPER CONNECTION.
2. BUTTSTRAP SHALL BE SHIPPED IN HALVES AND WELDED IN THE FIELD
3. PLATE THICKNESS SHALL BE EQUAL TO THE STEEL PIPE. MINIMUM THICKNESS SHALL BE 0.34".
4. SUBMIT SHOP DRAWINGS FOR REVIEW, CONSTRUCTION MATERIALS AND METHOD FOR TIE-IN.
5. CEMENT MORTAR COATING TO BE OMITTED IN AREA OF BUTT STRAP, MIN 6" CLEAR EACH SIDE.
6. REPAIR CEMENT MORTAR LINING AND PLACE CEMENT MORTAR COATING IN THE BUTT STRAP AREA IN ACCORDANCE WITH THE PIPE MANUFACTURERS REQUIREMENTS AND AWWA C205.



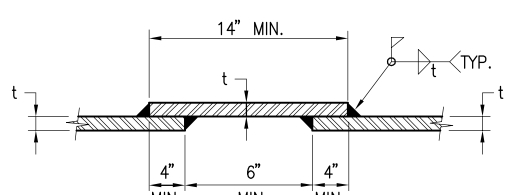

GUARD POST PLAN




REVERSE FOR OPPOSITE END OF JOINT

## NEW CML&C WSP JOINT TO EXISTING PRESTRESSED CONCRETE CYLINDER PIPE JIONT (5/–)

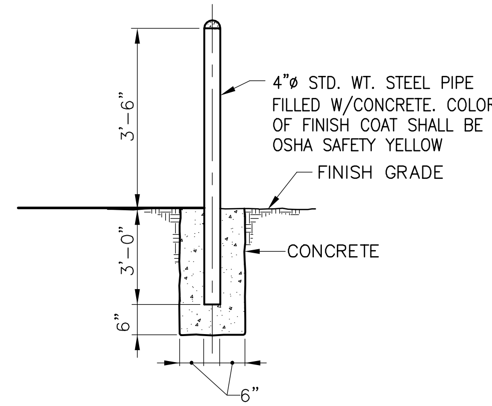
NOT TO SCALE




NOTE:
MINIMUM STEEL WALL THICKNESS AND FILLET WELD SIZE SHALL BE 0.34-INCHES

## BUTT STRAP JOINT DETAIL (4/–)

NOT TO SCALE




## GUARD POST (6/–)

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DATE: NOV. 2010

PROJECT ENGINEER: BEN P. HORN
REG NUMBER: C 23028 — EXP DATE: 12/31/11
PROJECT NUMBER: 60182837
CADD STANDARDS: AECOM

REGISTERED PROFESSIONAL ENGINEER — ERIC H. GARIBAY — No. RCE 72121 — EXP. 6-30-12 — CIVIL — STATE OF CALIFORNIA

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WSSP-2 TURNOUT

TURNOUT PIPING DETAILS

DRAWING C-03
SHEET 5 OF 6 SHEETS
S-2465

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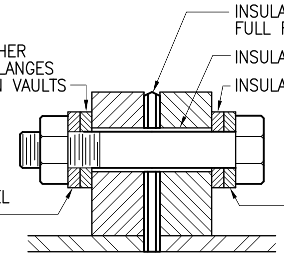
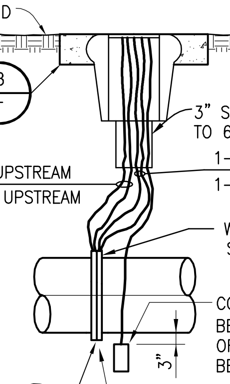


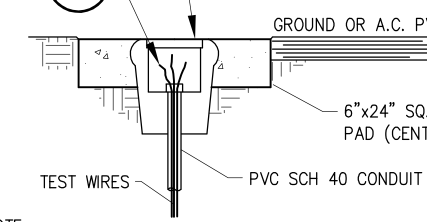

NOTES:

1. FOR CML&C STL. PIPE AND CCP STL. PIPE
2. PIPE SHALL INCLUDE E.M.S. PER DETAIL 2/– AT ALL BURIED INSULATED FLANGES.
3. PLACE NON-INSULATED FLANGE SIDE OF BOLT TOWARD VALVE
4. DO NOT APPLY METALLIC OR OTHER NON-INSULATING PAINTS TO INSULATING PARTS OR OTHER EDGES OF FLANGES
5. INSULATING SLEEVE TO BE 1/64" SHORTER THAN DISTANCE BETWEEN SST WASHERS WHEN BOLT IS FULLY TIGHTENED
6. INSULATING KIT TO BE PSI COMPANY TYPE "E" OR EQUAL.

## INSULATED FLANGE 1/–
NOT TO SCALE

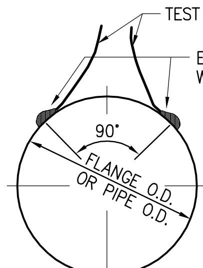



## E.M.S. AT INSULATED FLANGE 2/–
NOT TO SCALE



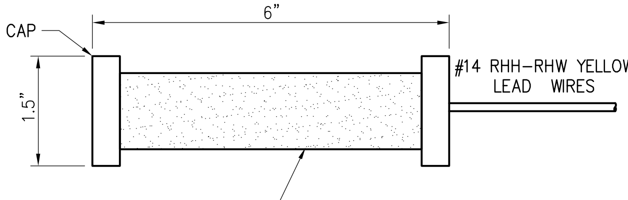

NOTE:
1. TEST BOX TO BE LOCATED ADJACENT TO VALVE BOX, SEE PLAN

## TEST BOX 3/–
NOT TO SCALE

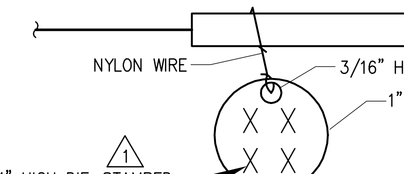



NOTE:
DO NOT WELD TO EXISTING PCCP

## DETAIL 4/–
NOT TO SCALE



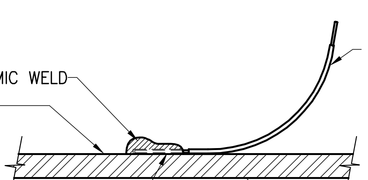

## COPPER SULFATE REFERENCE CELL 5/–
NOT TO SCALE



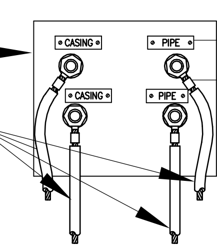

## CABLE IDENTIFIER & BRASS TAG DETAIL 6/–
NOT TO SCALE

NOTES:

1. USE PROPER BRAZE ALLOY FOR STEEL
2. CLEAN PIPE TO BRIGHT METAL.
3. THERMITE BRAZE TO BE CADWELD BY ERICO PRODUCTS OR EQUAL.
4. TEST BRAZE BY STRIKING SIDE OF BRAZE SHARPLY WITH A HAMMER. IF THE BRAZE COMES OFF: RECLEAN, REWELD, AND RETEST.
5. COAT WITH MINIMUM 3/4-INCH CEMENT MORTAR.




## EXOTHERMIC WIRE CONNECTION 7/–
NOT TO SCALE




E.M.S AT CASING

## LEAD WIRE TERMINAL BOARDS 8/–
NOT TO SCALE

Know what's below. Call before you dig.

| REV | DATE | DESCRIPTION | APPR |
|---|---|---|---|
| 1 | 12-03-10 | REVISED PER ADDENDUM NO. 1 | BPH |

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY: BPH
DRAWN BY: VENE
CHECKED BY: AR
DATE: NOV. 2010

PROJECT ENGINEER: BEN P. HORN
REG NUMBER: C 23028 EXP DATE: 12/31/11
PROJECT NUMBER: 60182837
CADD STANDARDS: AECOM

REGISTERED PROFESSIONAL ENGINEER ERIC H. GARIBAY No. RCE 72121 EXP. 6-30-12 CIVIL STATE OF CALIFORNIA

AECOM
AECOM USA, Inc.
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www.aecom.com

ANTELOPE VALLEY - EAST KERN WATER AGENCY
AVEK
ESTABLISHED 1959
A PUBLIC AGENCY

WSSP-2 TURNOUT

EMS DETAILS

DRAWING C-04
SHEET 6 OF 6 SHEETS
S-2465

DWG: S:\A01\60182837\WSSP-2\CAD\Planset\C-01-C-04.dwg Layout Name: C-04 - Plotted by: Campbell, Vene Date: 12/27/2010 - 1:04 PM
XREFS: S2465G-BD IMAGES: cyh-sign.jpg - sign.tif -

# Attachment 3 Exhibit
# Mitigation Measures Monitoring and Implementation Plan

# ANTELOPE VALLEY EAST KERN WATER AGENCY
# WSSP-2: GROUNDWATER RECHARGE PROJECT

# MITIGATED NEGATIVE DECLARATION
# SCH#: 2008071013

## Mitigation Monitoring and Reporting Program

AVEK WATER AGENCY
6500 West Avenue N
Palmdale, CA 93551-2855

August 2008

# MITIGATION MONITORING AND REPORTING PROGRAM

## 1. General

The Mitigated Negative Declaration for the Antelope Valley-East Kern Water Agency (AVEK) WSSP-2 Groundwater Recharge Project specified a number of impact avoidance, minimization, and monitoring measures to be undertaken during implementation of the Proposed Project. During implementation, it is essential that all of these be fully complied with and that compliance be documented clearly and in a timely manner. Failure to *comply* and/or *document compliance* could result in a challenge to the project and could result in serious and costly project delays.

A Mitigation Monitoring and Reporting Program (MMRP) has this been prepared for the Project and has been adopted concurrently with these Findings. (See Pub. Resources Code, § 21081.6, subd. (a)(1)). AVEK will use the MMRP to track compliance with Project mitigation measures. The final MMRP incorporates all mitigation measures adopted for the Project. In adopting the Mitigated Negative Declaration for the Proposed Project, AVEK's Board of Directors therefore also adopt this MMRP.

## 2. Responsibility for Compliance and Documentation

Implementation of the MMRP will be the responsibility of AVEK, which will assign a project manager to oversee all aspects of implementation of the proposed project and ensure that the mitigation and monitoring commitments made in the MND are carried out in a timely and effective manner. In implementing the MMRP, AVEK will often rely on the expertise and staff of outside contractors. Specifically, the day-to-day implementation of construction-related mitigation, such as measures for control of dust during construction, will be delegated to the construction contractor. To ensure the effectiveness of this mitigation and monitoring, AVEK will:

- Make the MMRP an element of all project-related requests for proposals and contract specifications, specifying that construction contractors will be responsible for appropriate acquisition of permits for construction and implementation of relevant mitigation and monitoring elements, as specified in this MMRP;
- Independently review contractor compliance on a regular basis and require corrective actions in a timely manner when AVEK determines that such actions are required;
- Maintain files, open to the public for inspection, documenting compliance with the MMRP, as outlined below;
- Designate an AVEK staff member to receive and respond to all public and agency comments, complaints, and/or questions regarding compliance with the MMRP; and
- Provide regulatory agencies with appropriate and timely documentation of compliance as specified in regulatory permits issued for the proposed project.

Table 1 (General Compliance Checklist) outlines the implementation process for each element of the MMRP. When an element of the MMRP is implemented, AVEK will manage compliance and use the checklist to document that it has implemented the specific MMRP elements required by the commitments of the Mitigated Negative Declaration (MND). AVEK may modify Table 1 to suit the specific requirements of any individual MMRP requirement.

**Table 1. Suggested General Compliance Checklist**

| MMRP REQUIREMENT | PERSON CERTIFYING COMPLIANCE | INITIALS |
|---|---|---|
| PROJECT ELEMENT OR SITE NAME: ___________________________ | | |
| Contact local city to obtain encroachment permit requirements | | |
| MMRP requirements included in RFP | | |
| MMRP requirements included in Contract Scope | | |
| AVEK Opens compliance file | | |
| Contractor has designated compliance contact for project | | |
| AVEK has designated compliance contact for project | | |
| AVEK/contractor has developed schedule for coordination with regulatory agencies | | |
| AVEK has determined necessary pre-activity training requirements | | |
| Pre-activity training requirements have been developed | | |
| Pre-activity training has been conducted | | |

In addition, AVEK shall require that construction contractors shall designate a principal mitigation and monitoring manager (Principal) and back-up compliance manager (Alternate) for each construction site and shall ensure that at least one of these is on-site during all phases of construction. In addition, for activities which may cause fugitive dust, either the Principal or Alternate must be available on weekends to respond to fugitive dust complaints (if any) and to respond to security and other issues. These persons may perform other tasks, but shall have adequate time, training, and expertise to perform the required monitoring and documentation. The Principal shall be the contractor's construction field supervisor or assistant field supervisor. The Principal or Alternate shall independently verify compliance with required mitigation measures and shall indicate verification by filling out and signing the appropriate compliance checklist, thereby certifying compliance with all measures.

AVEK will also, at its discretion and as indicated in the MMRP, contract for specialized technical expertise related to compliance with biological resources, cultural resources, and other compliance activities which may be outside of the staff capabilities of construction contractors and/or which require independent oversight.

In addition, AVEK's contracts shall specify that AVEK may at any time inspect construction sites and construction monitoring records, which shall be available and maintained in good order on site at all times.

As part of implementation of this general strategy for implementation of the MMRP, AVEK will maintain a complete list of designated internal and contractor compliance staff in a format similar to that listed below. If required, AVEK will notify appropriate agencies of the names and contact numbers of the AVEK compliance oversight personnel for the element of the project MMRP regulated by the agency.

For example, when preparing and implementing a Fugitive Dust Plan, AVEK will notify the AVAQMD and KCAPCD of the AVEK contact points for these plans and their implementation.

**Table 2. Suggested Compliance and Monitoring Staff Tracking Form**

| Responsible Party | Role in Project | Compliance Contact | Main Phone | Cell Phone |
|---|---|---|---|---|
| AVEK | Compliance oversight | Principal: | | |
| | | Alternate: | | |
| Construction Contractors | Well Construction (Site location) | Principal: | | |
| | | Alternate: | | |
| | Recharge Basin Const. (Site location) | Principal: | | |
| | | Alternate: | | |
| | Pipeline Const. (Site location) | Principal: | | |
| | | Alternate: | | |
| Independent Contractors | | Principal | | |
| | | Alternate | | |
| | | Principal: | | |
| | | Alternate: | | |
| | | Principal: | | |
| | | Alternate: | | |
| | | Principal | | |
| | | Alternate | | |

# 3. Permits and Coordination

The MND identifies a number of permits which may need to be obtained for various aspects of the Proposed Project, as well as commitments to coordinate design, pre-construction, and construction activities with various local, regional, State of California, and federal agencies. Permits and coordination commitments are:

- Kern County encroachment permit for any work in the public right of way
- Los Angeles County encroachment permit for any work in the public right of way
- Caltrans encroachment permit for work along Highway 138
- California Department of Public Health Public Water System Permit for wells and water treatment facilities
- Lahontan Regional Water Quality Control Board approval of a Storm Water Pollution Prevention Plan
- California Department of Fish and Game Streambed Alteration Permit (if defined drainages are impacted)

# 4. Incidents and Compliance Reporting

Timely reporting of compliance and of any incidents which may result in non-compliance is essential. Contracts for construction and for independent compliance contractors shall therefore specify that, if the designated construction contractor or independent monitor for an activity determines that any aspect of construction is not in substantive compliance with the mitigation requirements for the activity, the contractor and/or monitor shall immediately take action to remedy the problem. The designated monitor shall notify AVEK within not more than 24 hours following determination that any aspect of construction activity is not in compliance with mitigation requirements, shall explain how the incident has been addressed, and shall provide any other information requested by AVEK. Following action to address the out-of-compliance incident, the designated monitor must complete an "incident report" and submit a copy of this report to the AVEK compliance manager within one week of the incident.

# 5. Mitigation and Monitoring Program Updates

AVEK recognizes that laws, regulations, and policies related to construction activities may change during construction. The AVEK compliance manager and/or alternate are responsible for periodically reviewing the status of laws, regulations, and guidelines applicable to their construction activity. AVEK will implement any new rules in effect at the time of approval. Updates for some aspects of the project may be obtained from:

- Air Quality: Antelope Valley Air Quality Management District and Kern County Air Pollution Prevention District
- Traffic Controls: Both Caltrans and local cities comply with the OSHA *Manual of Uniform Traffic Control Devices* (www.osha.gov/doc/highway_workzones/mutcd).
- Threatened and Endangered Species: USFWS Ventura Office; CDFG Region 6 Office in Bishop

# 6. Staff Awareness

Staff must be informed of mitigation and monitoring requirements prior to construction. New staff must be oriented when they come on site. The Principal/Alternate therefore needs to review compliance requirements and monitoring requirements for the job with all personnel on site to ensure that they know the requirements, know the importance of compliance, know that violations must be reported, and know that compliance is a condition of employment on this job. Similarly, a summary list of mitigation and monitoring requirements shall be posted in a conspicuous location at the job site so that they may be referred to at any time. Staff that repeatedly violate mitigation and/or monitoring requirements shall be removed from the job site.

# 7. Training

If specialized expertise is necessary for mitigation or monitoring, the construction contractor shall provide such training to the person responsible for compliance and/or monitoring. For example, maintenance of equipment may be required to comply with Air Quality mitigation requirements. The construction contractor shall ensure that staff with adequate expertise for this activity are available to perform it. Similarly, monitoring may require the use of specialized equipment; staff with expertise, training, and/or experience in the use of such equipment must be available on a timely basis. All staff will receive training related to cultural resources compliance and, where there is potential for construction to affect protected environmental resources, biological resources compliance.

# 8. On-going Documentation

Compliance will be monitored on a timely basis, depending on the nature of the activity and the mitigation requirement. For example, for control of fugitive dust, trucks hauling loads of soil, rock, and other materials that may generate dust from the construction site must be covered. It is appropriate and necessary to document that each truck has been covered prior to allowing the truck to leave the construction site.

Where appropriate. photo documentation of pre-construction conditions, of activities during construction, of any incidents that may constitute a violation of mitigation requirements, and of post construction conditions is encouraged. However, if photo documentation is adopted as a monitoring tool, then it must be used consistently to ensure that there are records of all activities for which compliance must be documented. Labels must be explanatory and contain adequate information about the photographer, date, time, and conditions when the photo was taken. Photo documentation shall be backed up with paper copies and/or records on CD/DVD.

AVEK may audit records of compliance with mitigation and monitoring requirements at any time and compliance records must be readily available and in good order. Logs of mitigation and monitoring compliance should be maintained and supporting documentation should be provided in parallel to the log, in the same file. Files should be clearly labeled by the type of compliance being monitored. AVEK and its construction manager and other contractors will maintain such records in a form suitable for the required monitoring and reporting. It is anticipated that contractors will generally have appropriate monitoring templates for typical construction activities. In other cases, the format of compliance monitoring records may be available from the regulatory agency approving the monitoring (if any).

# 9. Pre-Construction Training

Prior to initiation of construction activity, AVEK will review the mitigation commitments in this MMRP and will determine the need for pre-construction training. AVEK and its contractors will prepare appropriate training materials and provide appropriate training to construction staff to ensure that they fully understand compliance and reporting requirements. It is anticipated that pre-construction training may be necessary for the following:

- Activities that involve excavation (cultural, biological, dust, noise, traffic)
- Activities that involve use of heavy equipment (dust, noise)
- Activities in the vicinity of trees (biological)
- Activities in the vicinity of public and private utilities

# 10. Mitigation and Monitoring requirements

## 10.1 Aesthetics

MMRP COMMITMENT

The MND commits AVEK to implement the following measures to reduce the potential impacts of the project on local community aesthetic resources:

**A-1: Design for above ground facilities compatibility**. As part of the development of this facility, AVEK will develop a design and coloration for the facility which would be consistent with the community character. For example, AVEK would consider painting the water storage tank to further reduce its visual impact by making its coloration blend in with the surrounding vegetation.

**A-2: Partial Tank Burial.** AVEK will minimize impacts by partially burying water storage tanks to reduce their visual impact.

**A-3: Screening.** AVEK will plant and maintain trees and other vegetation to screen the view of water storage tanks from nearby residences and roads. Colored fencing will be used.

**A-4: Lighting.** AVEK will provide for any lighting to be directed away from nearby residences. Outside lighting will on during operation and maintenance during recovery operations. When personnel are not on site, outdoor lighting will be turned off.

**A-5: Siting.** AVEK will site its water storage, treatment, and pumping facility at least 250 yards to the west of 80$^{th}$ Street west.

IMPLEMENTATION

AVEK's compliance manager for the Proposed Project will incorporate these mitigations into the design and construction contracts for the project and will review plans and other design materials to ensure that these measures are implemented.

## 10.2 Agriculture

No mitigation was proposed or needed.

## 10.3. Air Quality

MMRP COMMITMENT

In the MND, AVEK committed to implement the following mitigations for project air quality impacts:

**GENERAL:** AVEK will comply with all applicable AVAQMD and KCAPCD rules and incorporates these rules by reference into this Mitigated Negative Declaration and will implement Best Available

Control Measures from AVAQMD (2005 and any appropriate updates) that are appropriate and applicable to the Proposed Project. AVEK will prepare a Fugitive Dust Management Plan for the project. Pending adoptions of agricultural dust control measures by the AVAQMD, AVEK and the grower will also develop an appropriate plan for reducing fugitive dust emissions during agricultural use, considering a suite of potential agricultural emissions measures shown on Table 3.

**Table 3. Best Available Control Measures (BACMs) to be considered to minimize emissions from farming (San Joaquin Valley Air Pollution Control District and Imperial County APCD).**

| Best Available Control Measure | Description |
|---|---|
| **COMBINED OPERATION** | Combine equipment, to perform several operations during one pass. |
| **CONSERVATION TILLAGE** | Types of tillage that reduce loss of soil and water in comparison to Conventional Tillage |
| **COVER CROPS** | Use seeding of plants to cover soil surface. It reduces soil disturbance due to wind erosion and entrainment. |
| **EQUIPMENT CHANGES/TECHNOLOGICAL IMPROVEMENTS** | Modify the equipment such as tilling; increase equipment size; modify land planning and land leveling; matching the equipment to row spacing; granting to new varieties or other technological improvements. |
| **PRE-HARVEST SOIL PREPARATION** | Apply a light amount of water or stabilizing material to soil prior to harvest (when possible). |
| **RESTRICTED ACCESS** | Restrict public access to private roads. |
| **SPEED LIMITS** | Enforcement of speeds that reduce visible dust emissions. |

Although AVEK will apply the BMP's approved by AVAQMD (2005 and subsequent) as appropriate, AVEK commits to the following specific Air Quality Mitigation measures.

**Measure AIR-1: Fugitive Dust Control BMP's**

AVEK will prepare and implement a Fugitive Dust Control Plan, and as applicable to the Proposed Project will adopt the following AVAQMD and KCAPCD recommended control measures for construction emissions of PM10:

1. All material excavated or graded will be sufficiently watered to prevent excessive dust. Watering will occur as needed with complete coverage of disturbed areas. Watering will occur a minimum of twice daily on unpaved/untreated roads and on disturbed areas with active operations.
2. All clearing, grading, earth moving and excavation activities will cease during periods when either wind speeds exceed 25 mph or dust plumes of 20 percent or greater opacity affect public roads or occupied structures.
3. All material transported off site will be either sufficiently watered or securely covered to prevent excessive dust.
4. If more than 5,000 cubic yards of fill material will be imported or exported from the site, then all haul trucks will be required to exit the site via an access point where a gravel pad or grizzly has been installed.
5. Areas disturbed by clearing, earth moving or excavation activities will be minimized at all times.
6. Stockpiles of dirt or other fine loose material will be stabilized by watering or other appropriate method to prevent wind-blown fugitive dust and covered with tarps as needed.

7. Where acceptable to the fire department, weed control will be accomplished by mowing instead of discing, thereby leaving the ground undisturbed and with a mulch covering.
8. When material are transported off-site, all material shall be covered, effectively wetted to limit visible dust emission, or at least six inches of freeboard space from the top of the container shall be maintained.
9. All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at least once every 24 hours when operations are occurring. (the use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. Use of blower devices is expressly forbidden.)
10. Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant.
11. Traffic and speeds on unpaved roads will be limited to 15 mph.
12. Sandbags or other erosion control measures are installed to prevent silt runoff to public roadways from sites with a slope greater than one percent.

**Measure AIR-2: Vehicle Emissions Control BMPs**

1. During project construction, on-site mobile equipment shall be equipped with NOx reduction equipment and/or newer NOx limited engines will be required.
2. On-site mobile equipment will be equipped with $PM_{10}$ pollution control devices and/or newer, less polluting equipment will be required (either lower emissions diesel or alternative fuels engines).
3. On-site equipment will utilize aqueous diesel fuel.
4. AVEK will comply with all current and future Regulation VIII rules.
5. AVEK will require that all diesel engines be shut off when not in use to reduce emissions from idling.

**Measure AIR 3: Coating BMPs**

AVEK will adopt architectural coatings measures consistent with ARB's Suggested Control Measure (SCM) which limits the content of VOC in architectural coatings to between 100-730 g/l. ARB's SCM was adopted in June 22, 2000.

<u>IMPLEMENTATION</u>

AVEK will incorporate the above commitments into all construction and management contracts for the proposed project. For on-going operational elements of the proposed project, AVEK will appoint a compliance manager who will develop and implement monitoring and management procedures. The compliance manager will make annual reports to the Board of Directors regarding compliance with on-going commitments. The annual report will be transmitted to the AVAQMD and KCAPCD within 1 month following Board acceptance.

## 10.4 Biological Resources

MMRP COMMITMENT

The MND commits AVEK to implementation of the following impact avoidance and minimization measures.

**Mitigation Measure BIO-1:** Preconstruction surveys shall be conducted by a qualified biologist within the work area and a 250-foot buffer to locate active burrowing owl burrows. The Project will provide a qualified biologist to conduct these preconstruction surveys for active burrows according to DFG guidelines. The preconstruction surveys will include a nesting season survey and a wintering season survey the season immediately preceding construction. If no burrowing owls are detected, no further mitigation is required. If burrowing owls are detected within 250 feet of proposed construction within the Project area, the following measures will be implemented:

- Occupied burrows will not be disturbed during the nesting season (February 1–August 31).
- When destruction of occupied burrows is unavoidable during the non-nesting season (September 1–January 31), unsuitable burrows will be enhanced (enlarged or cleared of debris).
- If owls must be moved away from the Project area, passive relocation techniques (e.g., installing one-way doors at burrow entrances) will be used instead of trapping. At least 1 week will be necessary to accomplish passive relocation and allow owls to acclimate to alternate burrows.
- If avoidance is the preferred method of dealing with potential impacts, no disturbance should occur within 160 feet of occupied burrows during the non-breeding season (September 1–January 31) or within 250 feet during the breeding season.

**Mitigation Measure BIO-2**: If construction activities occur during the Swainson's hawk nesting season (March 1–September 15), the Project will provide a qualified biologist to conduct preconstruction surveys to locate all active nest sites within 0.5 mile of the construction area. If occupied Swainson's hawk nests are found, the Project, in consultation with DFG, shall establish a buffer zone around active Swainson's hawk nests in the vicinity of the Project area. The buffer zone shall be marked with specific identifiable flagging or fencing. Construction activities shall be restricted from the buffer around the active nests until after chicks have fledged. Whenever construction occurs within 0.25 mile of an active nest, a biological monitor shall observe the nesting hawks for stressed/detrimental behavior that threatens nest success. If there appears to be a threat to nesting success resulting from construction activity within the 0.25-mile buffer, work shall be halted until the hawk's behavior normalizes. The most obvious and dangerous "detrimental behavior" occurs when the hawk is scared off the nest. If that occurs (even momentarily), construction shall stop immediately within 0.25 mile of the nest for at least 1 hour after the hawk returns to the nest and her behavior appears to normalize. When construction resumes, if the hawk is scared off the nest a second time, construction will be prohibited within that 0.25-mile zone until having consulted with DFG to discuss further options. Other stressors/detrimental behaviors that the monitor shall look for include the hawk being off the eggs while still on the nest (e.g., circling/walking around the nest and calling). The biological monitor shall also watch for signs that the hawks are paying attention to construction instead of behaving normally (e.g., sitting calmly on the nest, watching out for or scaring away potential predators).

**Mitigation Measure BIO-3.** AVEK would preclude impacts to wildlife using the pipeline alignment or the area near the storage tanks as a movement corridor by isolating the area of open excavation with a mesh construction fencing. This will generally prevent animals from accessing the trench and becoming trapped. In addition, the contractor will also cover the pipeline opening before leaving the site to prevent animals from entering the pipeline and will place ramps at either end of the open trench so that any animals getting through the fence may easily escape the trench. When the new construction day begins, the crews will open the exclusion fence at each end to allow animals to escape. In addition, if construction equipment is to be stored on site overnight, AVEK will also contract with a qualified biologist to provide construction crews with training on how to recognize and avoid impacts to animals that may use the shelter of construction equipment. The training will stress that if animals are found beneath equipment, the biologist should be contacted and animals should be allowed to move away from the site before equipment is moved.

IMPLEMENTATION

The timing of implementation of each of the above mitigation measures is shown on Table 4

**Table 4. Schedule of Biological Resources Mitigations.**

| Mitigation Measure | Month when mitigation element applies | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | F | M | A | M | J | J | A | S | O | N | D |
| BIO 1 Survey Required | | | | | | | | | | | | |
| BIO-1 Nest Avoidance | | | | | | | | | | | | |
| BIO-1 Non-nesting | | | | | | | | | | | | |
| BIO-2 Nest Avoidance | | | | | | | | | | | | |
| BIO-3 construction monitoring | | | | | | | | | | | | |

To implement these mitigation measures, AVEK's compliance manager for the project will contract with a qualified biologist for pre-construction survey and construction monitoring (as appropriate to the requirement) at least 1 month prior to initiation of construction. As needed, the biologist will provide construction staff training. The biologist will be on-call during the period when the appropriate mitigation requirement is implemented. The biologist shall have authority to halt construction activities or re-direct such activities if it is determined that construction is having an adverse impact on any protected species. AVEK will ensure that any unanticipated impacts to protected status species are immediately reported to California Department of Fish and Game and US Fish and Wildlife Service.

## 10.5 Cultural Resources

MMRP COMMITMENT

The MND commits AVEK to implement the following mitigation measures, which emphasize avoidance and minimization of impacts.

**CR-1 Avoidance of impacts:** AVEK will consult with the grower and a professional archeologist regarding the appropriate continued use of lands at Æ -AVEK 1and may allow continued farming consistent with implementation of practices that avoid impact to this site.
**CR-2 Cultural Resources Testing and Evaluation**: If avoidance of Æ-AVEK-1 through Æ-AVEK-5 is not a feasible management option, then Phase-II testing efforts will be conducted at each of these sites to determine the presence/absence of buried cultural deposits, the content, integrity, and data potential of these buried cultural deposits if present, and the site's eligibility for inclusion in the CRHR.
**CR-3: Cultural Resources Management During Construction**: Considering that the extensive cultural deposits identified at Æ-AVEK-1 appear to be emanating from a buried cultural stratum lacking surface manifestations, and these deposits are only evident within areas where ground disturbance has intruded into and/or exposed this cultural stratum, potentially significant archaeological resources lacking surface manifestations may also be encountered in buried contexts during Project construction in areas other than those already identified. If potentially significant archaeological resources are discovered during construction and implementation of the proposed Project, these resources must be inventoried and evaluated to ascertain whether the resource meets the criteria for listing on the California Register of Historical Resources. Therefore, in the event of an accidental discovery of cultural resources during Project construction and implementation, all work being conducted within the vicinity of the discovery will be halted or diverted away from the site of discovery until a qualified archaeologist can assess the potential significance of the find.
**CR-4: Compliance with all applicable Regulations**: AVEK will comply with Health and Safety Code 7050.5, CEQA 15064.5(e), and Public Resources Code 5097.98, which mandate the process to be followed in the unlikely event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

IMPLEMENTATION

AVEK will engage the services of a qualified archeologist to (a) provide pre-construction training for crews and (b) be on-call during construction activities that have potential to impact cultural resources, as noted above. Archeological crews will instruct construction crews regarding (1) the possibility of unearthing cultural artifacts during construction, (2) the types of artifacts which may be unearthed and how to recognize them, and (3) the requirement that they immediately halt work when such artifacts are unearthed.

Construction contractors will develop scheduling and phasing alternatives for each project element to allow construction to proceed at another site while any archeological resources identified during construction are treated in accordance the commitments made in the MND.

AVEK will retain archeological monitors during construction for ground-disturbing activities that have the potential to impact significant archeological remains as determined by a qualified archeologist. Based on this policy and the results of literature search and field surveys, AVEK would implement the monitoring provision above for the following facilities:

- Well field delivery pipelines
- Pipelines connecting the recharge area to the storage, treatment, and pumping facility
- Excavation of the storage tank

Because previously unrecorded and/or unanticipated archaeological deposits, features, and Native American burials may be encountered during implementation of the Project, the Project Archaeologist would prepare a *Construction Phase Monitoring and Cultural Resources Treatment Plan* prior to Project construction. The purpose of this *Plan* would be to clearly outline and expedite the process by which the Mojave Water Agency will resolve any significant impacts upon newly discovered, historically significant cultural resources, including consultation with the State Historic Preservation Officer (SHPO), thereby eliminating untimely and costly delays in construction. Specifically, the *Plan* would outline the process by which cultural resource discovery notifications are made and treatment plans are implemented, describe the cultural resource classes anticipated during Project construction, describe the treatment options for each cultural resource class, and detail procedures for implementing treatment. In addition, the *Plan* would summarize the Native American involvement in the Project (including a sample Native American Burial Agreement), outline the procedures for curation of materials recovered during site treatment (including a proposed Archaeological Curation Agreement with a facility that meets California curation standards), and address report requirements. This *Plan* would be submitted to the SHPO for review and comment prior to Project construction.

## 10.6. Energy Use

<u>MMRP COMMITMENT</u>

AVEK is committed to energy conservation. In addition to the innovative approach to recharge basin design and operation, to minimize energy use associated with the project, AVEK will:

- Install electric pumps on extraction wells to take advantage of the wind-driven power generators in the AVEK area;
- Install energy efficient machinery and lighting at its in-line treatment facilities; and
- Require construction contractors to utilize efficient construction equipment and manage this use to minimize waste by turning off equipment when it has been idling for longer than 5 minutes.

IMPLEMENTATION

These commitments will be incorporated into design and construction contracts, which shall be reviewed by the project compliance manager. Construction site supervisors shall be responsible for ensuring idling restrictions are enforced.

## 10.7 Geology and Soils

MMRP COMMITMENT

The MND commits AVEK to implement a suite of impact avoidance and minimization measures for potential impacts to geology and soils:

**Mitigation Measure GEO-1.** To control water erosion during construction and operation of the Project, AVEK will prepare a Stormwater Pollution Prevention Plan (SWPPP) in compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) General Construction Permit.

**Mitigation Measure GEO-2**. Although the proposed project has little inherent potential for causing seismic safety effects, AVEK will ensure that all facilities are designed to withstand the anticipated seismic forces, consistent with local and state building codes and relevant regulations.

**Mitigation Measure GEO-3.** AVEK will install shut off valves on major pipelines and at the in-line water treatment units and monitor them (in the same manner that it presently monitors water supply operations) to minimize the potential for leakage during seismic events.

**Mitigation Measures GEO-4.** AVEK will store water treatment chemicals in secondary containment units to minimize the potential for leakage during seismic events.

**Mitigation Measure GEO-5.** Although the potential for the project to raise groundwater levels to within 30-50 feet of the ground surface is very small, to address potential impacts to local groundwater levels, AVEK, in cooperation with USGS, CDPH, and other regulatory agencies with jurisdiction over groundwater recharge recovery, will develop a monitoring program to monitor changes in water levels in the area affected by groundwater recharge operations. If monitoring identifies groundwater level rise to 75 feet below ground surface, AVEK would alter management of recharge to prevent water levels from rising to levels where liquefaction effects could occur. This commitment to cooperative monitoring extends to water quality monitoring as well.

**Mitigation Measure HAZ-1.** Consistent with AVEK's existing practices and recognizing that AVEK employs personnel with hazardous materials handling training, AVEK will develop and implement a Spill Prevention Control and Countermeasures Plan (SPCCP) to minimize the potential for, and effects from, spills of hazardous, toxic, or petroleum substances during construction activities and operations. The plan and methods shall be in conformance with all state and federal water quality regulations. The SPCCP will be reviewed by agencies with jurisdiction over this aspect of the Proposed Project before the onset of construction activities. AVEK shall provide for routine inspection of the construction and operations areas to verify that the measures specified in the SPCCP are properly implemented and maintained and further ensure that contractors are notified immediately if there is a noncompliance issue and will require compliance.

**IMPLEMENTATION**

AVEK's compliance manager shall ensure that the above mitigation measures are incorporated into construction and operation contracts and/or internal AVEK manuals for operations. The compliance manager shall annually review requirements for management of hazardous materials and AVEK shall update equipment and procedures to provide for compliance.

If construction and operation result in storm water runoff with adverse consequences, AVEK will inform the RWQCB of this and shall update its SWPPP accordingly in coordination with the RWQCB.

If construction and operation result in hazardous spills, AVEK will inform the RWQCB and update its SPCCP accordingly.

## 10.8 Hazards and Hazardous Materials

<u>MMRP COMMITMENTS</u>

The MND commits AVEK to implement the following impact avoidance and minimization measures to address the potential for impacts related to hazardous materials spills, aircraft-bird strikes, and mosquito abatement.

**Mitigation Measure HAZ-1.** Consistent with AVEK's existing practices and recognizing that AVEK employs personnel with hazardous materials handling training, AVEK will develop and implement a Spill Prevention Control and Countermeasures Plan (SPCCP) to minimize the potential for, and effects from, spills of hazardous, toxic, or petroleum substances during construction activities and operations. The plan and methods shall be in conformance with all state and federal water quality regulations. The SPCCP will be reviewed by agencies with jurisdiction over this aspect of the Proposed Project before the onset of construction activities. AVEK shall provide for routine inspection of the construction and operations areas to verify that the measures specified in the SPCCP are properly implemented and maintained and further ensure that contractors are notified immediately if there is a noncompliance issue and will require compliance.

The federal reportable spill quantity for petroleum products, as defined in EPA's CFR (40 CFR 110), is any oil spill that 1) violates applicable water quality standards, 2) causes a film or sheen upon or discoloration of the water surface or adjoining shoreline, or 3) causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines. If a spill is reportable, the contractor's superintendent shall notify the applicant who shall inform the applicable County agency and arrange for the appropriate safety and cleanup crews to ensure the spill prevention plan is followed. A written description of reportable releases must be submitted to the Regional Water Quality Control Board and the applicable County agencies. This submittal must include a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases would be documented on a spill report form. If a spill has occurred, the applicant shall coordinate with responsible regulatory agencies to implement measures to control and abate contamination.

This mitigation measure shall be applied to the 5 existing sites on the recharge alternative areas where preliminary studies indicate that there may have been spills of petroleum products or agricultural chemicals. These sites shall be remediated per the SPCCP prior to introduction of recharge waters to the affected areas.

Chemical handling for the in-line treatment units would be in accordance with best management practices. Chemicals of concern would be stored separately, with secondary containment vessels able to contain 1.5 times the volume held by the storage tanks. Chemicals transported, stored, and used in chloramination are sodium hypochlorate and ammonia. These and any other chemicals of concern would be transported in a manner consistent with all safety regulations.

**Mitigation Measure HAZ-2.** Several factors are incorporated into the design of the Project will discourage bird attraction, including:

- Use of a pivot to deliver water to recharge, resulting in a continuous disturbance regime at the recharge sites.
- The project involves recharge with shallow water depths which will be generally unsuitable for the larger migratory birds such as ducks, geese, and swans; and
- The project will not generally provide a crop cover in the winter that would provide for foraging habitat for other birds.

**Mitigation Measure HAZ-3**. For recharge using flood irrigation methods, AVEK will monitor recharge area water and if aquatic macroinvertebrates are found to be developing in large numbers and/or foraging by shorebirds is observed, AVEK will temporarily dry out recharge areas, thereby reducing the insect and aquatic macroinvertebrate forage that would attract and hold shorebirds. Forage support for wintering populations will be minimal.

**Mitigation Measure HAZ-4*:*** Prior to application of water to the recharge basins, the Project operator will notify the Flight Safety Office for the R-2508 Air Complex and all local airports of anticipated recharge operations.

**Mitigation Measure HAZ-5*:*** Whenever water is present in the recharge basins, the project operator will monitor the basins daily for bird activity. If large birds (e.g., geese, gulls, ducks, stilts, avocets, etc.) or large concentrations of small birds (e.g., horned larks, starlings, blackbirds, etc.) are observed in or near the recharge areas, the Flight Safety Office for the R-2508 Air Complex and all local airports will be notified of the potential hazard immediately.

**Mitigation Measure HAZ-6*:*** If flocks of large birds (e.g., geese, gulls, ducks, stilts, avocets, etc.) or large flocks of small birds (e.g., horned larks, starlings, blackbirds, etc.) are observed, the applicant or the Project operator will harass the birds to discourage use of the recharge basins using methods approved by the California Department of Fish and Game (DFG).

**Mitigation Measure HAZ-7**: AVEK will consult with Antelope Valley Mosquito and Vector Control District to develop a mosquito management plan and may contract with the District to assist in its implementation. The agreement will consist of a Project-specific mosquito abatement program that would include quantitative abatement thresholds. AVEK and/or the Mosquito Abatement District would monitor mosquito larvae production in the recharge basins, drainages, and distribution. Larvae populations would be tracked using methods and thresholds approved by the Mosquito Abatement District, and suppression measures would be employed when thresholds are exceeded. The primary mode of suppression would be (a) monitor for mosquito presence and (b) if mosquito larvae are found, to cycle recharge temporarily so that units of recharge would be dried at least once weekly, as recommended by the Antelope Valley Mosquito and Vector Control District in their June 18, 2007 letter to AVEK. The AVMVCD notes in its letter that "The best way to disrupt mosquito lifecycle and thereby reducing the need for pesticides is to let the field completely dry out once per week."

IMPLEMENTATION

Prior to implementation of elements of the projects that may involve the use, handling, transport, or storage of hazardous materials, AVEK will incorporate provisions of **HAZ-1** into construction and operation contracts and internal operations manuals. During construction, AVEK's designated compliance manager will provide for crew training in the handling of hazardous materials and the construction contractor shall develop and maintain a log of all compliance issues. Any substantial hazardous material problem will be reported to appropriate county and state regulatory agencies.

During the construction period, AVEK's designated compliance manager will conduct weekly site inspections and any violations of HAZ-1 shall be noted and corrected within 1 day following inspection. The compliance manager shall keep a record of any observed violations. During construction, the Board of Directors shall be informed of any serious hazardous materials issues and the AVEK staff response to these issues at the first scheduled Board meeting following the incident.

Within 6 months following the adoption of the MND, the AVEK compliance manager, in coordination with Edwards AFB personnel, will prepare a monitoring and management protocol for the operation of recharge areas that will include monitoring and reporting of the presence, relative number, and species of birds that may use the recharge sites. The monitoring and management protocol will at a minimum implement the provisions of HAZ-2 through HAZ-6, although he compliance manager may develop other measures as deemed appropriate.

Prior to initial recharge, AVEK will, in coordination with the Antelope Valley Mosquito and Vector Control District (AVMVCD) will complete development of a mosquito abatement plan for the recharge operations. This plan will be incorporated into AVEK internal operations manuals. AVEK will designate an operations monitor to ensure that the terms and conditions of the mosquito abatement plan are implemented. An annual report shall be prepared for the Board of Directors and submitted to the AVMVCD following acceptance by the Board of Directors.

## 10.9 Hydrology and Water Quality

MMRP COMMITMENT

The MND commits AVEK to a comprehensive monitoring and reporting program for hydrology and water quality:

**Measure HWQ-1. Design to manage runoff.** If pivots are used, then there will essentially be no change in ground contours and no change in the management of flood flows. As noted in the project description, if agricultural flood irrigation methods are used, recharge areas would be constructed so that they would not divert sheet flooding and other runoff away from the recharge areas. This would allow floods water to flow into the recharge areas where flows would be somewhat retarded by the recharge berms. Downslope perimeter berms would also be designed to retard flood flows, but, if breached, flow would be collected in a low drainage swale outside of the perimeter berms to distribute flows laterally so that they would become sheet flow on existing the site.

AVEK has added the following to this mitigation measure: If flood irrigation type berms are constructed to contain recharge water, AVEK will monitor weather forecasts and, if substantial rainfall is expected and the berms are in place, will monitor on site and will have equipment ready to remove berms if flooding appears eminent. This will reduce the already insignificant potential for flood irrigation techniques to affect flood flows.

**Measure HWQ-2. Remove berms following recharge if needed**. If concerns are raised regarding the effects of berms on flooding, AVEK will remove them after each recharge cycle when planting the required post-recharge cover crop.

**Measure HWQ-3**. **Stormwater Pollution Prevention Plan (SWPPP).** To reduce or eliminate construction-related water quality effects, before onset of any construction activities, AVEK or its contractor will prepare a Storm Water Pollution Prevention Plan. The SWPPP will include temporary erosion control measures (such as silt fences, staked straw bales/wattles, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, and temporary revegetation or other ground cover) will be employed to control erosion from disturbed areas. Measures for the control of pollutants during construction include:

- Use existing access points to minimize dust and tracking materials onto Public Streets;
- Designated Parking, Storage, and Service Area protected by silt fence and oil absorbents and sloped to control drainage;
- Minimize diesel storage;
- Stockpile spill cleanup materials;
- Regular vehicle inspection for leaks;
- Fuel off-channel with a secondary containment system for spills;
- Use quick connects when-ever possible;
- Fueling by Authorized Personnel only; and
- Spill cleanup materials readily available

Note also that a Fugitive Dust Control Plan (FDCP) will be prepared and implemented and will include extensive measures to control and manage soil erosion. The FDCP will provide for management of open soils that will contribute to management of runoff. In response to comments, the project description has been modified to indicate that parking will be either gravel or permanent pavement.

Consistent with the SWPPP and AVEK's current construction management practices, AVEK or its agent will perform routine inspections of the construction area to verify that the BMPs specified in the SWPPP are properly implemented and maintained. AVEK will notify its contractors immediately if there is a noncompliance issue and will require compliance.

**Measure HWQ-4. Spill Prevention Control and Countermeasures Plan.** Prior to any construction activities and during operation of all facilities, AVEK shall develop and implement a Spill Prevention Control and Countermeasures Plan (SPCCP) to minimize the potential for, and effects from, spills of hazardous, toxic, or petroleum substances during construction activities and operations. The plan and methods shall be in conformance with all state and federal water quality regulations. Los Angeles and Kern county environmental health services departments shall review the SPCCP before the onset of construction activities. Consistent with its current construction management practices, AVEK shall provide for routine inspection of the construction and operations areas to verify that the measures specified in the SPCCP are properly implemented and maintained and further ensure that contractors are notified immediately if there is a noncompliance issue and will require compliance.

The federal reportable spill quantity for petroleum products, as defined in EPA's CFR (40 CFR 110), is any oil spill that 1) violates applicable water quality standards, 2) causes a film or sheen upon or discoloration of the water surface or adjoining shoreline, or 3) causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor's superintendent shall notify the applicant who shall inform the applicable County agency and arrange for the appropriate safety and cleanup crews to ensure the spill prevention plan is followed. A written description of reportable releases must be submitted to the Regional Water Quality Control Board and the applicable County agencies. This submittal must include a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases would be documented on a spill report form.

If a spill has occurred, the applicant shall coordinate with responsible regulatory agencies to implement measures to control and abate contamination. To prevent spills:

- All fuels and lubricants for construction equipment will be stored out of the channel within containment structures with a capacity of at least 1.5 times the capacity of storage tanks. Fueling operations will be conducted outside of the channel on impervious surfaces in dedicated areas at least 15 m from the interior slope of levees, sloped away from the levee; if at any time this is not feasible, drip pans will be used for all fueling. Equipment maintenance will be conducted outside of the channel if feasible in dedicated areas at least 15 m from the interior slope of the channel, sloped away from the levee; if equipment must be repaired within the channel, drip pans will be used. Fueling and equipment maintenance areas will be protected from run-on and runoff.

- Material storage areas will be cleaned routinely and appropriate cleaning materials will be stock piled to ensure their availability when needed. Construction materials will be stored on pallets and covered prior to closing the construction site each day. Concrete and equipment washout areas will be adequate in size to contain washout water, lined with PVC, and inspected daily to ensure that liners are free of punctures. On-road equipment will be washed in appropriate containment areas prior to entering the roadway. Haul loads will be covered. Trash receptacles will be provided, emptied at the end of each day, and trash hauled to a certified disposal site.

Used (empty) containers for fuel, lubricant, and other construction chemicals will be collected and removed from the site at the end of each construction day.

Chemical spills will be reported and cleaned up immediately by appropriately trained hazardous materials personnel. Any contaminated soils will be hauled from the site and disposed of at a facility authorized to take contaminated materials. Following spill clean-up, soils will be tested to ensure that contaminants have been effectively removed from the site.

**Measure HWQ-5. Retention of flow on site at the storage, treatment, and pumping facility**. The partial burying of storage tanks will involve net removal of about 150,000 cubic feet of soil. This will be used in landscaping and/or spread over the adjacent 80 acres. Spreading the soil over 80 acres would result in a net change in land surface elevation of 0.045 feet, or about 0.5 inches, and no significant change in land elevation is therefore anticipated. To further mitigate this minor effect, AVEK will make the spoil from excavation available to others for purposes such as landscaping and road construction. AVEK has modified this mitigation measure in response to comments and will (a) provide for retention of runoff from the water tanks and buildings on site and will not spread the excess soil, but will sell it for uses off site. There is a demand for this soil and AVEK sees no impediment to focusing on this aspect of the mitigation. Sale and removal of the soil from the site will eliminate any potential for the Proposed project to impact flood flows passing over the land adjacent to the storage, treatment, and pumping facility.

**Measure HWQ-6. Protection of off-site wells.** To address potential impacts to groundwater and adjacent well owners, AVEK will develop a monitoring program to monitor changes in water levels and well production in the area affected by groundwater recharge operations. The program will specify that:

- To alleviate overdraft, extractions of groundwater shall not exceed 90% of the amount of water recharged.
- Water quality in recovered water and in groundwater flowing away from the Project will be monitored to ensure that water quality remains appropriate for designated beneficial uses;
- During recharge operations, water levels in perimeter wells will be monitored and recharge operations will be suspended in the event that offsite water levels rise to within 20 feet of the ground surface; and
- During recovery operations, water levels in offsite wells will be monitored and operations will be adjusted if offsite wells are found to be adversely affected by project operations,
- If project operations are substantially affecting offsite wells, then AVEK will provide compensation, or an alternate source of water. Alternative water may be provided by allowing agricultural users to use existing AVEK facilities associated with the West Feeder and domestic users may be provided with domestic supply connections from AVEK's treated water system.

AVEK will invite the input of the local community in developing and implementing its monitoring program. Technical advice will be provided from USGS, California Department of Public Health and/or other agencies with regulatory authority over these aspects of the Proposed Project. In addition, AVEK will coordinate with the operators of the WDS Bank during recovery operations, including sharing monitoring data.

In addition, consistent with the request from the Lahontan RWQCB, AVEK will work with the RWQCB prior to implementation of the project to develop a specific and implementable monitoring plan to address mineral and chemical leaching from the vadose zone. Preliminary to this, the RWQCB requests AVEK initiate a vadose zone study to quantify potential for leaching.

**Mitigation Measure HWQ-7. Management of herbicides and pesticides.** AVEK will comply with all regulations of the California Department of Pesticide Regulation regarding the use of herbicides and pesticides in areas designated for groundwater recharge. AVEK will work with its agricultural lessees to provide for safe agricultural chemical containment during storage and handling for the protection of groundwater resources

## IMPLEMENTATION

AVEK will incorporate design-related mitigation measures into all design and construction contracts, which will be reviewed by the designated AVEK compliance manager for the project.

Prior to initiation of operations, AVEK will develop a coordination schedule for development the detailed monitoring plan and will provide this schedule to the Board of Directors. The schedule shall include at meetings with local residents within the community and coordination with operators of the WDS Bank and with local technical advisors from USGS, CDPH, the Lahontan RWQCB, and other state and county agencies as needed. When approved, the schedule will be posted in AVEK's headquarters building and local residents win areas potentially affected by the project shall receive invitations to the specified public coordination meetings.

The detailed groundwater monitoring plan will be developed within 1 year following adoption of the MND. When completed, it will be reviewed and adopted by the Board of Directors and made available to the public. The plan will include:

- Monitoring of all production wells and smaller monitoring wells for depth, minerals, and agricultural chemicals, including fuels and other hydrocarbons, the presence of any herbicides or pesticides known to have been applied in farming operations prior to and during the operations of the water recharge project, and all mineral components for which there are current State drinking water standards. Wells will be located on site and downslope to characterize flow, depth, and water quality over a period of years.
- Prior to implementation, AVEK will initiate a monitoring program to characterize vadose zone leaching of minerals, pesticides, and herbicides. There are a variety of field methods for this type of monitoring:
    1. Drilling to obtain sample soil cores to a depth below the vadose zone allows a comparison of soil chemistry at various levels and times during before, during, and following recharge and agricultural operations. Cores taken before initial recharge will provide baseline data.
    2. Passive wick lysimeters and gravity pan samplers may also be installed to measure actual leaching rates in the vadose zone within the first 2 meters.
    3. Porous cup samplers installed in sealed vertical auger holes may also be installed to a depth of 1-3 meters to collect water percolated through the soil for sampling and analysis.

4. Shallow monitoring wells may also be drilled and perforated casing installed at different levels to measure the flow of water and chemicals through the zone between the vadose zone and the groundwater.

A program for sampling of the vadose zone and soils below the vadose zone involving these or other typically applied methods will be undertaken in cooperation with USGS and the Lahontan RWQCB. AVEK will initiate discussions the specific methods to be used and the study design immediately following adoption of the Mitigated Negative Declaration and adoption of the project.

## 10.10 Noise

MMRP COMMITMENT

**Measure NOISE-1. General noise reduction strategies.** If residences are present within the threshold distances determined above, the construction contractor will employ noise reducing construction practices so that noise from construction does not exceed noise-level standards at adjacent residences. Measures to be implemented may include the following:

- Providing construction equipment with sound-control devices no less effective than those provided on the original equipment (no equipment will have an unmuffled exhaust);
- Restricting construction to beyond 2,800 feet from residences during nighttime hours (10 p.m. to 7 a.m.) and beyond 1,200 feet at all other times; and
- In the event that construction activities occur close to sensitive noise receptors, implementing appropriate additional noise mitigation measures, including but not limited to:
    - (a) changing the location of stationary construction equipment,
    - (b) shutting off idling equipment,
    - (c) rescheduling construction activity,
    - (d) notifying adjacent residents in advance of construction work, and
    - (e) installing acoustic barriers around stationary construction noise sources.

**Measure NOISE-2. Noise containment and blocking.** When construction of facilities is within 200 feet of a residence, construction noise levels will be monitored at the structure. If noise levels are found to exceed 65 dBA at the structure and the property owner requests noise reduction, AVEK will provide and install temporary noise screening panels to block construction noise. These panels will be removed when construction activity is 200 feet or more from the residence. In addition, well pumps will be enclosed in a noise-reducing structure, such as block walls.

IMPLEMENTATION

AVEK will incorporate noise mitigation measures into all construction contracts and into AVEK operations manuals. AVEK's designated compliance manager will review construction contracts to ensure compliance. During construction, the contractor shall provide for noise monitoring and AVEK will provide local residents with information regarding the timing and duration of construction activities, with a telephone contact they may use to report excessive noise to AVEK. AVEK notes that the Antelope Acres Town Counsel prefers reduction structures to be placed without property owner permission, but there are few impacts along the pipelines in the vicinity of this small community, which is primarily focused on the area east of 90th Street West. AVEK will therefore notify property owners along all alignments of the potential for construction noise and request that they indicate whether they would permit the placement of noise reduction facilities between their residences and the construction zone. AVEK will then monitor as specified and follow the resident's wishes.

AVEK will respond to any report of excessive noise within 1 day following the report, will independently measure noise levels, and will modify implementation of noise management measures as needed. Noise complaints will be recorded and the Board of Directors will be informed of them in routine project progress reports.

## 10.11 Traffic

<u>MMRP COMMITMENT</u>

The MND commits AVEK to manage construction and operation related traffic in a manner consistent with local and state requirements.

**Measure TR-1. Traffic Safety Plan.** AVEK will require the construction contractor to prepare/implement a traffic safety plan before the onset of the construction phase of the Project. The traffic safety plan shall be reviewed and approved by the Kern County Roads Department for affected roads in Kern County and the Los Angeles County Public Works Department for affected roads in Los Angeles County. The plan shall address:

- Appropriate vehicle size and speed,
- Travel routes,
- Detour or lane-closure plans,
- Flagperson requirements,
- Locations of turnouts to be constructed,
- Coordination with law enforcement and fire control agencies,
- Coordination with California Department of Transportation personnel (for work affecting state road rights-of-way),
- Emergency access to ensure public safety, and
- Traffic and speed limit signs.

**Measure TR-2.** Coordination with emergency response agencies. Before beginning construction activities, the applicant or the construction contractor shall contact local emergency-response agencies (Kern County and Los Angeles County Sheriff and Fire Departments) to provide information on the timing and location of any traffic control measures required to complete the Project. Emergency-response agencies would be notified of any change to traffic control measures as the construction phases proceed so that emergency-response providers can modify their response routes to ensure that response time would not be affected.

**Measure TR-3. Parking**. To address parking issues, any buildings associated with the Proposed Project that will be used by operational staff shall be designed to comply with Chapter 19.82 (Off-Street Parking) of the Kern County Zoning Ordinance.

**Measure TR-4. Driveway access.** AVEK will notify residents along the pipeline alignments where construction may block driveway access at least 2 weeks in advance. To the extent possible, AVEK will schedule construction so that driveways will not be blocked for more than 1 day and will coordinate with residents to provide alternative access.

IMPLEMENTATION

At least 1 month prior to initiation of construction than may cause traffic impacts (primarily construction related to pipelines that are constructed within the public right-of-way along roads), AVEK's construction contractors shall provide AVEK's compliance manager with a traffic safety plan that has been reviewed and approved by the transportation department of the county in which the project activities will occur and/or California Department of Transportation, as applicable. This requirement shall be incorporated into design and construction contracts as appropriate.

Regarding driveway access, AVEKs objective is to a) avoid impacts to driveways to the extent possible and (b) if access must be affected to restrict access only during period of active construction and only during daylight hours. AVEK's designated compliance manager will develop a schedule for construction that may affect residents and shall provide residents with a written notice and copy of the schedule at least 2 weeks in advance of construction. The notice shall include reference to the above mitigation measures for traffic management. The notice shall provide residents and businesses with a contact telephone number. If driveway access is a problem, AVEK will meet with the affected residents and develop driveway access plans to minimize potential impacts.

## 10.12 Utilities

COMMITMENT

AVEK's commitment to avoid impacts to SCE facilities is clarified. Consistent with the request from SCE, AVEK will coordinate with SCE regarding the location of their facilities and will develop specific plans for their protection. We note that this is typically done during design.

IMPLEMENTATION

The designated AVEK compliance manager will contact SCE operations personnel within 1 month of adoption of the MND and the MMRP and will establish a coordinating group consisting of the design contractor, the compliance manager, and a representative from SCE. AVEK will request detailed maps of major SCE facilities and during design will use the maps as a guide for developing specific alignments and for developing means of avoiding impacts to existing facilities. Impact avoidance protocols for utilities will be incorporated into the various construction contracts.